

A  
CRITICAL INQUIRY  
INTO THE  
MOTION OF THE SUN  
AND  
STABILITY OF THE EARTH.

Mac Calman 19

K



STABILITY OF THE EARTH



A  
CRITICAL INQUIRY  
INTO THE  
MOTION OF THE SUN  
AND  
STABILITY OF THE EARTH.

By GODFREY M<sup>c</sup>CALMAN, Surgeon in GREENOCK.

---

*medio tutissima pendet terra.*

---

*Quid verum atque decens curo et rogo, et omnis in hoc sum.*

HOR.

L O N D O N :

Printed for G. G. J. & J. ROBINSON, Pater Noster Row; JOHN  
BELL, Edinburgh; and J. & W. SHAW, Glasgow.

MDCCLXXXVI.

# CRITICAL INQUIRY

CONDUCTED INTO THE

MOTION OF THE SUN



STATIONERS' HALL. Entered in Stationers' Hall.

BY GODFREY MCGILLIVRAY, Surgeon in GREENOCK.

Printed and sold by G. J. & J. K. in the Strand, at the sign of the Sun.

H. K.

L O N D O N

Printed for G. J. & J. K. in the Strand, at the sign of the Sun.

Printed by W. Smith, in the Strand, at the sign of the Sun.

MDCCCXXXV

# CONTENTS.

## INTRODUCTION.

Page  
9

## SECTION I.

*A stricture on the rise and spirit of the theory, revived in the 16th century by Copernicus, and, about 160 years afterwards, showed susceptible of mathematical demonstration by Sir Isaac Newton; respecting planetary phenomena in the worldly system.*

29

## SECTION II.

*A decerptive view of the Newtonian design, in order to make planetary motion and other physical phenomena more reconcilable.*

42

## SECTION III.

*Observations showing the insufficiency and ob-  
scurity of the Newtonian Hypotheses, par-  
ticularly, so far as they refer to universal  
gravitation.* — — —

55

## SECTION IV.

*The mechanical or Hutchinsonian system. —  
Reflections upon the Newtonian philosophy.*

77

## SECTION V.

*Electricity, seemingly, the chief power in the  
universe. — The theory of the sun, &c.*

91

## SECTION VI.

*The same subject continued.*

107

## SECTION VII.

*Hypotheses regarding the positions and phases  
of the earth, sun, moon, &c.* —

124



CONTENTS. vii

SECTION VIII.

Page

*Objections shown against the planetism of the earth.* — — — 141

SECTION IX.

*The same subject continued.* 156.

SECTION X.

*Electric phenomena, especially attraction and repulsion, explained on mechanical principles.* — — — 169

SECTION XI.

*An attempt to show mechanical causes for the suspension and equilibration of the earth, in the centre of the expanded system of nature.* 184

SECTION XII.

*The same subject continued.* 194

CONTENTS

Page

SECTION VIII.

Objections against the plausibility of the

— — — — —

SECTION IX.

The same subject continued.

SECTION X.

Magnetic phenomena, especially attraction and  
repulsion, explained on mechanical prin-

— — — — —

SECTION XI.

An attempt to discover a cause for the

suspension and oscillation of the earth, in

the centre of the expanded system of nature.

SECTION XII.

The same subject continued.

## INTRODUCTION.

**T**HE vast progress, and useful as well as pleasant discoveries, which have been already made in natural sciences, may be a plea for saying; pointing out more would be superfluous, and only tend to run us overmuch into fits of idle speculation, and fields of trifling novelty.

Such apprehension, however, will appear premature, and not well founded, when we consider how nature daily lays open, to every mind that is disposed to explore her minutely, objects and scenes, which are at least new to it; and that may serve as fresh sources for perpetual observations, without being able at last, after every endeavour, to trace her but imperfectly, either in the extent of her existence, or the diffusiveness of her operations and appearances.

In all ages, philosophical researches, it is true,

may be said to have perplexed, not less than enlarged, the contemplative mind; whose feelings were never regaled so opportunely by them as by the superficial survey of a flower-garden, or the sweet performance of a fine piece of music; it being continually obliged, not only to check and modify its own emotions and fallies, but likewise keep guard, nay, sometimes wage war against the unprovoked cavils, and cynic attacks of others.

Hence, the fame and credit of natural theories, particularly, came to be evermore in a fluctuating state, sometimes rising and at other times falling in estimation, like the movements of a balance, in proportion to the number of admirers and abettors, that each of them chanced to catch; and this has been the fate of theories, from the dawn of systemizing down to the present day. A system, indeed, often became stationary for many hundred years together; the most eminent one, that now assigns principles to astronomy and certain other branches of natural philosophy, and which is held, almost universally, at present, in the repute of a standard, is of a very late date; the



time, since people began to foother themselves into an implicit acquiescence in it, has not yet amounted to one century.

This scheme, for some time past, threw a veil over every other, that had been proposed or set on foot before, and its stamp the mass of writers, reluctant to alter hardly a single device, have prided to make use of since its first appearance in the Newtonian garb. But let us consider, that the lessons and doctrine of some men, even of blazing parts and attainments, may not unfitly be compared to flowers, that have a set time wherein they flourish and excel others, and a stated period in which they fail and fade.

Experience, in any long course of years, will make mankind acquainted with numberless appearances and secrets in nature, which their predecessors were ignorant of, and that no strength of genius could divine. Notwithstanding, tenets neither wanting excellence nor merit, though antique, may be observed on the one hand verging fast into oblivion, being deleted by time or de-

ferted through prejudice; while others again, unworthy to be called any thing else but mere casual thoughts, are flashing abroad in their room, under the show of new discoveries.

The world, in its scenic appearances and incidences, is not unlike a wheel continually revolving, upon which human things and concerns rise and fall; every thing under the sun is subject to mutability, and there is none so transient and changeable as the thoughts and ideas of man. The political acts and statutes, the manners and customs, the fashions and forms, with which a country is enamoured and captivated in one century, become not only seemingly full of defects and unfashionable, but perhaps odious, until their very traces are almost obliterated in the next. To us, the aspect of the whole animate and inanimate creation is varnished with newness, and reciprocally we wear new faces to them: therefor, casual notions concerning the establishment of the universe must invariably spring and decay with every generation, and in turns be warmed or chilled again by the hand of time. Indeed, it

plainly appears to be the design of the universal Ruler of the world, in all his dispensations towards the human race, to mix light with darkness, evidence with uncertainty, and knowledge with ignorance; thus, man is left in a state of conjecture and partial information. We tread in the sphere of life, likely in many respects, as if it were within what people call an enchanted circle, where things are shown in an incomprehensible and feigned light. The nakedness of the universe is masked, and we see at present but dimly as through a glass.

Some observe, that, to suppose there are but this one earth and yon one sun in existence, would be entertaining a poor and diminutive opinion only of the Creator's creative power. In reply to this, it is granted there may be infinite other schemes of creation, and why not? But in fact, no one of them ever yet became the object of any one faculty or sense of ours, unless in the shape of a phantom to the imagination; the word or thing *universe*, therefor, should not be conceived in a greater latitude of meaning, neither expressive

nor descriptive of more bodies than are usually understood to be situated within the limits of that sphere, commonly called the solar system; if the imagination-department of the mind extends beyond those bounds, it may be challenged for trespassing its own precincts and jurisdiction. It appears far more agreeable to the impenetrable mysteries of wise Providence in other respects, as well as to the œconomy and plan of humanity in general, to reserve any eccentric works, there may be co-existing, detached and concealed from our view. How vain would it seem in the shell-animal, or even in the prone quadruped, to attempt stretching their vision beyond those lines originally marked out by the hand of nature to them? As well, in defiance to our speculative curiosity and restless propensity towards the marvellous, the contemplative faculty of the human mind, like the eye, has it sensible horizon. †

---

† *Philosophy, says Fontenelle, is founded upon these two propositions. 1. That we are too short sighted. 2. That we are too curious.*



The wonderful, not to say the fabulous, complexion of philosophy in our days, regarding the *wordly system*, justifies an observation made by *Lord Bacon*, namely, that an opinion of plenty is one of the principal causes of want. Mankind do not at present assuredly know, whether thy are flying upon the back of the world, so to speak, through the boundless regions of absolute space, with greater speed than the swiftest bird of the air, and in a quicker career if possible than that of lightning itself, or whether they stand still on immovable ground. Nay, the learned inquiries of past ages cannot determine, whether this globe of ours be the centre, or a paltry spot situated outwards and towards the extremity, or if it is the primary object, or only a secondary one, in the visible system of nature. † How hard and almost impossible must the business be, to attempt unfolding and adjusting problems and doubts so extremely contradictory and so long unsettled!

---

† *This made Archimedes of Syracuse to say, let me have but a place to stand upon, and I will turn the world which way I please.*

The spacious volume of nature is spread equally open and displayed to all, and we may say in this country, that our lot is fortunately to live under a government and police, where learning is unfettered, being neither confined into the abstruse stores of a few closets and libraries, nor cooped up within the doors of inaccessible convents and palaces. Every one has a right to investigate the constitution, and purpose, of those sensible objects and *phenomena* which present themselves around; but in order to accomplish this, he should endeavour to be first divested of the bias and spirit of pre-judging, that are too frequently observed retarding the exertions of pure and sound reason, and standing as mounds in the way of viewing nature in her true colours.

People are apt to measure every thing by their own favourite ways of thinking, and creep into the same mistake with some painters, who inconsiderately are wedded to their own tints, or the manner of their masters, and when once such a habit is rooted in them, they delineate nature not as she really is, but as they are in use to paint her.

The destruction of zealotism and bigotry, always so baneful and subversive to true science, would be of universal service; and more especially to them, whose habitual fashion is to form opinions superficially and according to mere usage. There is occasion for the curb as much as for the spur; why, we are by no means servilely to give way to the loose musing of a *Greek*, to the bold assertions of a *Pole*, nor to the geometrical laws of a celebrated *Englishman*, further than their principles are competent, and sufficient to dictate to our own reason and eye-sight, or may seem qualified by scripture. These are, by far, the best and most sure criterions in the world to ascertain the truth of every thing as well as theories; ideal faith, or a bare and implicit belief of any kind, is, both in perspicuity and force, very inadequate to the evidence of our organical senses, the pure testimony of revelation, or the conclusive light of reason.

The infinite advantages and comforts, which every member derives from civil society, should induce him in a disinterested manner, and so far as his abilities allow, to contribute to the public

knowledge and good. On the other hand, the benevolent and social exertion of a private person towards an object of such general moment, though unsuccessful, merits approbation.

The author of the following piece is conscious of his own inability, to effect any thing equal to the substantial justice which the subject he treats of would require. His theme is so intricate and of such magnitude, that he often wished it had become the exercise of another, who might honestly pretend to superiour talents, and boast of a life blessed with more leisure and literary opportunities.

During his younger years, he confesses to have been a passive dupe to many specious theories in astronomy, that might have been rather called demagogue opinions; which, when he began in earnest to canvass and sift, he found much difficulty to be reconciled with, except when his faculties and senses were previously lulled a sleep. This ceremony was attended with too much self-denial and restraint at any rate, but so soon as he



adverted, that scripture countenanced; and even taught, the same which reason &c. suggested over and over again; thenceforth, he began to indulge the thought of publishing a few observations respecting some confutable notions that startled him not a little.

The examination of the frame of nature, so far as it is visible and palpable to man, it is easy to conceive, must form the most extensive branch of human knowledge; there, many difficulties may be expected to arise, however descriptive the survey may be. The evidence of our directive power *reason* and the strength of *analogy* are not, however, to be rejected in such cases, because the compass of our present state allows us to know only in part.

Things may be considered the objects either of our mental powers or external senses; soon as the latter cease to detect and comprehend what is passing in nature, then the mind takes up the business, and, by its conceptions, endeavours to discover what cannot be discerned or distinguished by the

senses, that is to say, what may be the cause, immediate influence, and end of every phenomenon; by this mean, the mind, again, combines the accuracy of observation with the sagacity of experience and rigour of argument.

That, which is comprehended by any affection produced in the organs of sense, is accordingly termed *sense*, and if not plucked away by reason, *science*; this is a firm, stable and immutable comprehension, because reason is in concert; whereas on the contrary, opinion is but an infirm and inaccurate assent, or a blind and submissive belief. Therefor, *science*, among the learned, is to be considered only *opinion*, on the side of the illiterate and ignorant.

The arguments proposed in the following tracts, to account for the suspension and equilibration of the *earth* in the centre of the expanded universe, have taken their rise from the Mosaic instruction in regard to the division of the waters, when in their primitive and chaotic state; likewise, from the mention made by *David* of the floods above

the heavens, whose sluices or windows were thrown open to expedite the catastrophe of the unfortunate eastern world, in the days of *Noah*; and especially, from the knowledge mankind have arrived at now, concerning the mechanism and universal power, which the *electric fluid* possesses and preserves throughout the whole system of nature. Without recourse to sophistry in order to disarm the more intelligent, or without the smallest design to decoy the weak and credulous, the author hopes to clear the way at least so far towards the re-establishment of the old persuasion, *that the earth is at rest*: † while he contends, that the intention and purpose of its creation, together with that of every other object situated within the limits and boundary of human vision, was for the accommodation and conveniency of man a-

---

† *Is there any thing whereof it may be said, see, this is new? It hath been already of old time, which was before us, says Solomon.*

lone, † and particularly, that the greater and smaller luminaries, which we behold regularly and permanently swimming as it were through the sky, are no more than fractional parts of our scheme. Man, says *Plato*, is the great chain that ties the world together; his rank is obviously supreme in the broad scale of created things, he is the chief of a *whole* seemingly in design and application subservient to him. All things live for man, says the unimitable divine and poet *Milton*. †

---

† *There are some, says Fontenelle, not unlike the Athenian idiot, who fancied that all the ships which entered the port of Pyrean belonged to himself. In defence of this idiotism it may be urged; provided, the importing and exporting shipping in the Pyrean trade were considered in the light of floating-stores, belonging to that town of which the idiot was a citizen, consequently, a connection might be traced between them. Whereas, if he had supposed every ship he saw to be a town like Pyrean, in that case, his whim would seem far more extravagant and confutable.*

† *Should a dependant person, after receiving a revocable honorary-title with an annuity of 1000l. a year from a Prince, become*



It is attempted by the author to explain, in a simple but probable manner, how we can account for the returns and variations of the seasons, without being obliged to imagine, that the earth is whirled round the sun, or he round the earth, yearly in the curves of conic sections, or any other zig-zag course whatever. Those vicissitudes, as appears to him, do recur rather in consequence of the sun's moving daily in an oblique and spiral direction round the earth his centre. How this escaped the notice of others is a little surprising! However novel the idea may seem, yet the scheme, in the meagre shape it is here set forth, is far less chimerical, and clogged with fewer difficulties, than any other heard of hitherto at least by him.

If these *hypotheses* and disquisitions shall, how-

---

*come selfish and vain or grateful and humble, in consequence of such a handsome donation?*

*The solution of this question requires little exertion of thought, and its faint analogy to the blessings of human life may preclude a very common and sneering remark, made here upon the vanity, or, as Pope says, the madness, of man.*

ever, in the course of their dispersion, be attacked with the asperity of censure; in that event, may *candour* crush *virulence* at giving a rub to one, who puts himself in the hands of chance, on his first journey and, perhaps, in an impassable road. Their proposer owns fallability in common with others, though he can never bring himself the length of seconding the man, whose outcry is; sooner mightest thou increase the splendour of the sun by a lighted taper, or add to the thunder by thy voice, than bring conviction into my mind, that *Copernicus* and *Sir Isaac Newton* could misapprehend, or possibly support any vulnerable theory.

What has been, from time to time, wrote upon the subject of electricity is very extensive. Every branch of science, during its rudimental state, undergoes wonderful agitations and distortions. Electricity was, for a long time, the favourite child of curiosity, which it held out to scepticism; the theme has been so warmly pursued, that, by the assiduity of several ingenious persons of the present age, in different countries, as well as by many fortuitous incidents, what was long ago, and still

is called the electric fluid, is now clearly proved and demonstrated, to be no other matter than the true element of fire, specifically instanced in the well known phenomenon of lightning. This element remains for the most part in a latent state; whenever it is disengaged from the other elements, from any violent agitation thereof, it becomes then visible, and has the appearance of a lambent fiery-fluid. Hence, the substance in question should, in stricter and more scientific language, be termed the *fiery-fluid*, and not the fluid of amber; it might be named the glass, or the silk fluid, with the same propriety as the electric.

After all that has been said, by different naturalists, in regard to the definition of elements, we may consider the *earthly-solid*, the *watery*, the *airy*, and the *fiery-fluids* to be the sole four species of matter or ingredients, which constitute the frame of nature. The last mentioned element is incomparably the most subtile and active, and is regarded in natural philosophy, at present, as the chief mover and prime agent among second causes, or the only material source and main spring of

physical action. It is, indeed, so much blended and enveloped with its fellow-elements, that it is only under certain circumstances it manifests itself to us, that is to say, when an extraordinary motion is excited by any mean in greater or less zones, or spaces, of it. Thus, by striking or rubbing smartly two hard stones, if extremely dry and clean, upon one another, or by the friction of two pieces of dry wood, † closely over the conductor, or wire, of a small Leyden-vial, a person, by skilful management, can charge the vial with the fire so produced, and afterwards perform every electric experiment *ceteris paribus*, or exhibit every phenomenon in electricity, with which people have been in use to amuse themselves since the days of *Prometheus*.

#### The surcharge of aerial zones in a high electri-

---

† In Kamtchatka, the inhabitants, in order to kindle fire, use a board of dry wood with round holes in the sides, and a small round stick; this they rub in one of the holes till it takes fire, and instead of tinder they apply dry grass, beat soft.



fied state, and that of an overcharged vial is manifested in a flame, perceptibly the same both in appearance and quality, and which can equally kindle not only inflammable and combustible substances; but, a measure of either can melt the most difficultly fused metals, *platina* not excepted, and even turn gold to glass, which has never been done yet by the fiercest furnace, nor the strongest burning mirror.

22 JY 59

A N I N Q U I R Y  
I N T O  
THE MOTION OF THE SUN  
AND THE  
STABILITY OF THE EARTH.

---

S E C T I O N I.

*A stricture on the rise and spirit of the theory, revived in the 16th century by Copernicus, and, about 160 years afterwards, showed susceptible of mathematical demonstration by Sir Isaac Newton; respecting planetary phenomena in the worldly system.*

THE generally received opinion of the present age concerning the earth, though far from being universally a confirmed and established one, is, that it is a wandering star, † moving in company with other erratic bodies round the sun, as their common centre.

---

† Or planet, from the Greek verb πλανω to err or wander.

The sentiments of the most early astronomers respecting the order of objects in our system, we are necessarily as ignorant of as we are of themselves: whatever theories are handed down to us, must be of a much later date than the first introduction of astronomical observations.

*Pythagoras*, a Greek philosopher, who flourished about 550 years prior to the Christian *era*, is said to be the first, who had thrown out an *hypothesis*, that the great appearances in nature might be as well explained, by supposing the earth to be in motion and the sun at rest.

In whatever light this part of the Pythagorean doctrine might be held, in those remote and darker ages, it will be granted, if such a supposition had been moved for the first time now, in our brighter days, it would have been laughed at, and reprobated as a flight of the imagination; some would even venture to say, a thought of this kind could not make its escape from the tutorage of reason, by any avenue and at no season, but amidst the lucid twinklings of a mind in an insane state. However disaffected to an *hypothesis*, which seems



at bottom to have nothing in it, I revere the name of its author, and wish to make mention of that venerable sage of antiquity with the greatest moderation and deference.

To ascribe no more than his due to him, let us observe, that he enforced this seeming chimera by no means as a positive position, or self-evident truth, but in the feeble form of a doubtful hint, or unevidenced conceit: an error of judgment, therefor, is not be palmed upon the cautious *to* mover, but is rather to be placed to the *debit* of those, who wantonly became future abettors of this loose and merely jocose slip of his. Our memorable philosopher taught and inculcated his lessons and precepts, invariably, in a figurative style, by symbols and types; which practice exercised and strained the power of his imagination to such a pitch, that there is little wonder in its frolicing and sporting at particular times, contrasting what is with what is not, to see how it would do, to reverse the positions and ordinary course of things. There is, in the next place, a natural preparation in the human mind, to receive impressions of be-

lief concerning whatever is preternatural; besides, a love to the marvellous, and ignorance are the two most ancient frailties of mankind. Upon these stems, the crude *hypothesis* of the Greek astronomer engrafted itself; thenceforth, the tare began to grow among the wheat until

*Ptolemæus*, an eminent Egyptian philosopher, took up the question relative to the suspected mobility and roving of the earth. This great man appeared in the world near 700 years after *Pythagoras*, and about 140 years after the birth of our Saviour. He ridiculed and confuted, in a masterly manner, the idea of the earth being in any sort of motion; he demonstrated and showed, that all the heavenly bodies rather revolved periodically round it. This system was afterwards espoused and maintained by the Aristotelians or Peripatetics, who were out of sight the most distinguished sect of philosophers, that flourished from the Ptolemæan age down to the revival of letters in the 16th century. The Ptolemaic was called by the Greeks a most wise and divine theory, while the very name of the Pythagorean was de-

tested, and though a Grecian bud, it passed as a despised outcast and an object of derision among them. And these were people, who are universally allowed to have been possessed of a subtle and inquisitive genius, and upon the whole, to have been a race of men, the most ingenious, the most animated, the most accomplished and refined in every sense, perhaps, that the world ever produced.

Antecedent to the bright century above referred to, a set of philosophers, commonly named Academics, introduced several jarring and turbulent principles and tenets into the world. Thus, *Arcefilas* declared, that there was nothing at all either certain or true, and that the positive and negative might be maintained in every subject. *Lacides* again acknowledged there was a degree of probability, but we could not assuredly know, if any thing was absolutely true. *Pyrrho* afterwards taught, that it was merely impossible to comprehend any thing, and he believed there was nothing at all so true, but what might be said to be either this or that. The Pyrrhonians were like-

wife called sceptics, because they searched without ever being able to discover any one thing, so universal was their doubt!

In the more distant ages, scepticism was exercised with less address and skill than in later times. A scholar then dogmatically took up and defended any end of an argument, as he thought with the Academics, that there was nothing so comprehensibly true but might be confuted, nor hardly any innuendable question, in which the affirmative and negative could not be indifferently applied; hence, it appeared preposterous, to take an active part in asserting any one end of a story in preference to the other, which could be conceived in whatever sense or light one had a mind. Such unfixed doctrine as this could not fail to involve those, who listened to it, into endless cavils and disputes; many obscure and arbitrary theories, consequently, came abroad as it were upon crutches, leaning on one side to fallacious and quibbling tenets and finical points of science; and on the other hand,



supporting themselves by strength of lungs, † petty  
strifes about words, silly syllogisms and the like.

In modern times, the spirit of scepticism has  
not subsided, though running in a different vein.  
Subtile theorists now proceed thus; they cull and  
particularize favourite proposals and premises,  
whence by induction they draw one or more ge-  
neral conclusions, which sometimes will admit of  
founding, but oftner shine, like *Will with a wisp*,  
most remarkably at a distance and when least ex-  
plored. A mathematician's business, says *Fonte-  
nelle*, is to draw a conclusion from the most trifling  
proposition you allow him, which necessarily com-  
mands an assent, and from this inference another,  
till he leads you so far, whether you will or not,  
that at last you have much ado to believe him.  
There is every manner of difference between ideas,  
some of them, far from being ground-works to

---

† Two friars warmly engaged once in a dispute about the  
plurality of worlds; one of them proved it briefly thus; were not  
ten worlds made? The other replied, but where are nine of those  
worlds?

principled theories, should rather be considered the primements of extravagant chimeras. Some men, bent on refinement, run every thing that comes in their way to extreme, *reason* itself not excepted; they spin their threads so exquisitely fine, that upon trial they will be found unfit to be interwoven in any texture calculated for use. The most that can be said of this matter is, no doubt sceptics sometimes hit the truth, but more frequently pass on the one side or other of the mark, and avoiding being wrecked upon *Scylla*, they are cast away on *Charybdis*.

Whether the exuberant gift of scepticism, or an itch after too minute speculation and scrutiny, arises from a luxuriancy of the imagination, or from a bustling habit and cultivation, and in whatever mode it may be practised, its tendency and scope plainly are to pester and overrun reason. All of us are witnesses to the propensity, avowedly shown by thousands of our own cotemporaries, to countenance the false as fast as the true end of any subject or cause, though indeed, it is not easy to assign a good reason for so much compliance and volun-

teering of the *will*. Ingenious and subtle men of such a turn cannot miss, however, by the energy of their persuasive logic and graceful eloquence, to lead the understanding of many into mazes of difficulties and tortuous notions. Then, to puzzled and overwhelmed minds, left perhaps without a natural perception of distinction either in principle or action, light and dark, sweet and bitter, true and false, right and wrong become almost the same.

About the beginning of the 16th century, an *era*, in which the literature of the world may be considered as hemmed within a narrow circle upon the continent of Europe, but when, after a long eclipse, it was just about to dawn abroad, and on the eve of taking wings, an ecclesiastic of Poland, by name *Copernicus*, happened to catch the debateful humour and false taste of those ages, and the field, he pitched upon for his sport, was the controversy concerning the mobility and immobility of the earth. Accordingly, he attempted a determination in favour of the Pythagorean *hypothesis*, the scoff of no fewer than 2080 years;

this he set about with a zeal much a-kin to the furious spirit of religious reformation, that characterized the period he lived in. His doctrine, because it was abundantly marvellous and out of the common line, as might be predicted, procured to him followers: a slight touch, nay, an imperceptible tremor of the air, is sufficient to sound strings which are easily vibrated. The number were, however, comparatively inconsiderable, who actually had the resolution to become converts, or were able to be up with his airy scheme any more than with a dream, for the space of 160 years.

During the currency of the 17th century, the Copernican astronomy, as it came to be then called, was opposed by many able philosophers, among whom were *Tycho Brabe*, a Dane, *Longomontanus*, &c. but warmly espoused by others, in the list of whom were *Descartes* of France, *Galileo* of Florence, *Gregory* and *Keil* of Scotland, &c.

Diffention now disseminated itself every where, and people's opinions and views concerning the establishment and order of objects in the worldly



system stood undecided, and in a controverted state, at the close of the last and commencement of the present age, when the Newtonian philosophy appeared, as it were, coming in a seasonable time to take the Copernican under its cover. That gay and amusive scheme of *Copernicus*, after receiving the colour and sanction of gravity from the Newtonian theories, has since forced its way almost into universal toleration; so much so, that astronomers, from that to the present time, have contented themselves with going no greater length, than to amass assemblages of observations and inquiries into the causes and *phenomena* of planetary motion. The most capital theories, adduced upon this subject, are the *Cartesian*, *Newtonian* and that which is called the *mechanical*.

*Descartes's* remarkable system of the *plenum* and *vortices* is well known; it seems to have been borrowed from *Democritus* and *Epicurus*, resembling that of the *Corpuscularians*, in accounting for all the appearances of the universe merely from matter and motion. By way of improvement upon former theories, which taught, that every

thing was formed by a particular motion of very minute particles or atoms, indivisible into smaller parts: he supposed the original parts of matter capable of being broken, and to this property his subtile matter owes its origin. To each small particle he attributed a motion upon its *axis*, and likewise insisted, that there was a general motion of the whole matter of the universe round, in the form of a whirlpool. The finer particles, which evaporated or were washed from the atoms, seceded and accumulated, according to their particular degree of rarity into different spaces; the finest of all assembled into the sun, which is the centre of the universe, and whose *vortex* is the whole ethereal matter in the creation. As all the planets, says he, are immersed in this whirlpool, they are carried round by it in different times, proportioned to their distances; those near the sun circulating briskly, and those farthest off more slowly. Besides this general solar whirlpool, each of the planets has a particular one of its own, by which their secondaries are distinctly carried about.

Agreeably to the planetary scheme, which *Copernicus* was pleased to make out and settle, *Descartes* arranged his *vortices*. In the centre he fixed the orbit of the sun, whose immense *vortex* extends to and comprehends the whole planetary whirlpools, limited to their respective orbits viz. 1. The Mercurial. 2. The Venetian. 3. The Terrestrial, with one satellite. † 4. The Martial,

---

† If our moon, Venus and Mercury, which are sometimes called the interior planets, be peopled like this globe; in that case, to avoid the scorching heat of the sun, the Planetians there must live perpetually at home in cavities or vaults, that by our telescopic observations are shown to have the appearance of wells or holes, and which probably may communicate by subterraneous passages. Though it is likely on the other hand, if the Mercurials, especially, had to encounter a climate, such as the Amazons and Ethiopians with us experience every March and September, they could not even in that case venture out of their dens, for fear of being frozen.

In like manner, the exterior 12 worlds of Planetians, to whom our Greenland would be abagnio, must always creep under ground, to avoid the nipping cold and other horrors of their long and dreary nights, the length of which in Saturn is said to be 15 years.

whose satellite or satellites have not as yet been discovered by the inhabitants of the Earth. 5. The Jovial, with four majestic moons. 6. And lastly, in the extremity of the solar system, the Saturnine *vortex* with five moons inclusive.

Upon what mechanical cause, or general law, all these operations and *phenomena* hinged, *Descartes* left unresolved, and went no further to prove the whole, together with the existence of his subtile matter, than by supposition.

---

## SECTION II.

*A decerptive view of the Newtonian design, in order to make planetary motion and other physical phenomena more reconcileable.*

**T**HAT the centre of the system of the world is immovable, says *Sir Isaac Newton*, is acknowledged by all, while some contend, it is the earth, others, the sun, that is fixed in that centre. The common centre of gravity of the earth, the



sun and all the planets, is to be esteemed the centre of the world: for since the earth, sun, and planets mutually gravitate one towards another, and are, therefor, according to their powers of gravity in perpetual agitation, as the laws of motion require, it is plain, that their movable centres cannot be taken for the immovable centre of the world. If that body were to be placed in the centre, towards which other bodies gravitate most, according to common opinion, that privilege ought to be allowed to the sun. But since the sun himself is moved, a fixed point is to be chosen, from which the centre of the sun recedes least, and from which it would recede yet less, if the body of the sun were denser and greater, and, therefor, less apt to be moved. †

Hitherto, says *Sir Isaac*, I have explained the *phenomena* of the heavens and our sea by the power of gravity, but have not yet assigned the cause of this power. This is certain that it must proceed from a cause, that penetrates to the very centres of

---

† *Princip. Book III. p. 232, & 233.*

the sun and planets, without suffering the least diminution of it's force. But as yet, I have not been able to discover the cause of those properties of gravity from *phenomena*, and I frame no *hypotheses*. †

Sir *Isaac* proceeding to reform astronomy, ‡ as some of his friends tell us, chalked out a quite different plan from every other natural philosopher who had gone before. He purposed to assume nothing as a supposition, which was not at the same time deducible from what is obvious to our eyes; and by arguing from those things that are within our reach, he thought we might come to know with certainty what happens in the regions of the air, to which access is denied us.

At a time when this accurate mathematician was fitting alone in a garden, he observed the fall

---

† *Princip. Book III. p. 392.*

‡ *A. D. 1686* ——— In his publications then, he had the friendly assistance of Dr. Halley, the brightest and most learned man, at that time in Britain.

of some apples from a tree, which circumstance, though trivial, led his thoughts away upon the subject of gravitation. Reflecting upon the power of that principle he considered, that as it is not found to be sensibly diminished at the remotest distance from the centre of the earth we can rise to, neither at the top of the loftiest building, nor upon the summit of the highest hill, it appeared to him reasonable to conclude, this power must extend much further than was usually thought; why not so far as the moon, said he, and if so, her motion must be influenced by it, perhaps, she is retained in her orbit thereby? He considered at the same time, if the moon was retained in her orbit by the force of gravity, no doubt the six primary planets were retained in their orbits by a similar gravitation towards the sun, this was inferred from the supposition, that those bodies moved in perfect circles round him. Again, by comparing the distances of the several planets from the sun, and of their secondaries from them, he observed the gravitating power towards each body to decrease, in proportion to the increase of distance from the sun or primary planet.

In the course of his observations on this subject, a very singular circumstance occurred, as taken notice of by himself, *to wit*, that the force of gravity was not at all proportional to the apparent bulk of the planets, or even of the sun himself. He was obliged, so as to obviate this seeming difficulty, or rather paradox, to assign a reason, why the gravity of celestial bodies does not keep pace with their quantity and bulk, as is the case in earthly ones. Observing the effect of fire upon our earth to be to rarefy bodies, whereby they are made to occupy a greater space than formerly; thence, he was induced to conclude, that the sun was of a more rare substance, or contained less matter in proportion to his bulk than the earth did; and considering the matter mathematically, he computed the sun to be four times rarer than the earth.

*Sir Isaac* opposed the Cartesian opinion concerning the revolutions of the planets, which was, that they are carried about in a whirlpool of fluid matter. He denied, that any motion could be continued in a fluid *medium*, because, whatever



body moved there, the same must communicate its motion to the fluid, and in the same stated degree as motion is communicated to the fluid, it must be lost to the body, &c. If such a vast whirlpool of fluid substance, as *Descartes* imagined, had existed, it is impossible without a continued miracle, but it must have carried along with itself the comets as well as the planets. For these reasons he concluded, that the celestial regions are entirely void of matter, excepting, perhaps, some rare exhalations from the planets, comets and rays of light; which substance was reckoned by him of such exquisite tenuity, as to give no sensible resistance to any body whatever.

The whole of the mathematical part of the Newtonian philosophy rests, fundamentally, on the following single position. Quantities and the ratios of quantities, which in any finite time continually converge to equality, and, before that time expires, approach nearer the one to the other, than by any given difference, become ultimately equal.

The following is one of those definitions, upon

which he erected his *New Principles*. The innate force of matter is an inactive or resisting power, by which every body, as much as in it lies, endeavours to persevere in its present state, whether of rest or moving uniformly forward in a right line; the difficulty that attends moving any body out of its original or primitive place justifies this, which he supposes to arise from its centripetal force or gravity. If the friction among the parts of a body could be removed, it would not take more force to move a tun-weight than one grain of sand.

Another leading position in this system is; that an impressed force is an action exerted upon a body, in order to change its state, either of rest or moving in a straight line forward. This force consists in the action only, and remains no longer in the body when the action is over, as a body maintains every new state it acquires by its inert power alone.

To account for the perpetual motions of the planets and comets in their orbits, *Sir Isaac* had

recourse to the force of gravity or a centripetal power, and a projectile or centrifugal force combined therewith. As he was ignorant of a natural power, by which the planets could be impelled in the direction of a tangent towards any part of their orbits, he was obliged to apply for one of his forces to the immediate action of the Deity himself. God, says he, having created this world, and impressed the universal law of attraction or gravity upon matter, impelled each of the planets in the direction of a right line, touching the most distant extremity of its orbit. Being immediately acted upon by the solar attraction, their courses were bent from a straight line into a circle, and the same cause still continuing to act, the original rectilinear-direction was changed into one nearly circular, which continues ever since. The same reason is assigned for the continued motion of the secondary planets round their primaries, but as to the revolutions of the earth, sun, and other planets upon their *axes*, we have not heard that he, or any of his followers, ever yet fixed upon a natural cause.

The manner, in which our astronomer demonstrates the operation of the projectile and gravitating forces upon the planets, so as to direct them in circles round the sun, is, by supposing the orbits which they describe to be divided into a number of infinitely small parts, each of which differs not from a right line, and consequently, the whole curve may be considered as it were a delineation of the diagonals of a parallelogram prodigiously small; one of whose sides might represent the space through which a planet moves by the projectile force alone, and the other that through which it moves by the force of gravity alone in an equal space of time—*Ferguson*, anxious to have this explained, says; from the universal projectile motion of bodies in straight lines and the universal power of attraction, which draws them off from those lines, the curvilinear motion of the planets arises. To make the projectile force balance the gravitating power so precisely, as that any body may move in a circle, the projectile velocity of the body must be such as it would have acquired by gravity alone, in falling through half a *radius* of the circle; that is to say, a single measure of pro-



jectile force is always enough to co-operate with a double portion of gravity.

Sir *Isaac* soon foregoes the idea of a planet moving in one curvilinear and uniform course round its centre, to the completion of a circle, which the above-mentioned law should suggest; in preference, he adopts an opinion of *Galileo*, namely, that while a secondary planet is circumvolving round its primary, it is describing an infinity of orbits returning into themselves, comparatively speaking, in the way a bout of a stocking is knitted. Planets, according to his idea, are capable to describe all kinds of *ellipses*, whether short or long, if the spaces they move in be void of resistance. Only those, which move in longer *ellipses*, have a less projectile force impressed on them in the higher parts of their orbits, whereby the cone, which is described by them, is as it were tapered and lengthened out; and in the next place, their velocity in coming down towards the sun is more than usually increased by his attraction, until their centrifugal force becomes so great, in the lower parts of their orbits, as to over-

come the sun's attraction there, which causes them to ascend again towards the higher parts of their orbits. During their ascension, the sun's attraction, acting so contrary to the motion of those bodies, occasions them to move slower and slower, till their projectile strength is diminished almost to nothing, when they are brought back with much rapidity by the solar attraction as before.

All parts of revolving bodies, agreeably to the principles of this system, endeavour to recede from the *axis* of motion, and the efforts of bodies moving forward arise from the conjoined efforts of all their parts.

This astronomer's account of cometary motion is; that comets revolve in very eccentric *ellipses*, because they only received a small degree of projection at first, for which reason they are brought very near the body of the sun by the force of gravity; from which they again acquire a vast degree of projectile power, that carries them off upon the other side of him, till being gradually

weakened by the attractive power they return, and so forth.

There are many who want to outvie and surpass *Sir Isaac Newton's hypotheses* and propositions, and elope by the specious ladder of analogy in the application of his demonstrations of planetary *phenomena* to still higher and more enlarged schemes, not to say flights, of creation.

The fixed stars, say they, are very likely all *suns*, each of whom is no doubt encompassed by his respective complement of primary and secondary planets, comets, &c. And because the boundary of gravitation cannot be ascertained, it is reasonable to think, that all the suns in absolute space have a projectile force too as well as the planets, and are gravitating towards one common centre; round which they describe orbits, carrying their planetary systems in a train with them, just as the primary planets carry about their secondaries, during their periodical revolutions round their peculiar suns.

Something, they apprehend, is necessary to counteract or divert the gravitation of the sun towards the planets, for though the projectile power hinders them to come too near him, yet what hinders him from coming to them? He, as *Sir Isaac* showed, is continually agitated and removed out of his place by their attraction. Difficulties of this kind pressed upon that philosopher himself, when he proposed the query, what hinders the fixed stars from falling upon one another? To show that this enquiry is far from wanting an object, it is urged by some that the stars *Sirius*, *Castor*, *Procyon*, *Regulus*, *Alpha*, *Aquila*, *Pollux*, *Arcturus* and many more are discovered to be moving, with amazing velocity, through the heavens. Indeed, the whole stars † in the expanse of heaven are suspected to be moving in the same way, and the assertion is supported by the respectable testimonies of *Halley*, *Maske-line*, *Lamont* and *Mayer*, all distinguished astronomers.

---

† The fixed stars were frequently observed by the Egyptians to be environed with comæ, or something resembling beards and tails.



## SECTION III.

*Observations showing the insufficiency and obscurity of the Newtonian hypotheses, particularly, so far as they refer to universal gravitation.*

**S**IR Isaac Newton showed infinite modesty respecting the belaboured query, where the immovable centre of the system of the world is placed. Nay, he passes by this question in a most reserved manner, referring an investigation of it to others; it is true, he seems to side the opinion of the earth's planetism, while with the same breath and in the same sentence he asserts, that the sun's moveable centre or axis cannot be taken for the immovable centre of the world. Allowing this philosopher's opinion to be the best upon our subject, and beyond which we cannot go; notwithstanding, we are still left by it at a prodigious *nonplus*; the earth, the sun, &c. are thus in actual motion, why, we must, it seems, sail out of this universe to the unknown regions of absolute space in quest of an *immovable centre*! Had Sir

*Isaac* lived 50 or 60 years longer, and been put upon to resolve and come to a peremptory decision as to a fixed centre; perhaps, the idea of *centrum incognitum alibi* would have vanished out of his mind, in a similar way as the notion of *terra australis incognita* has deserted the heads of mankind within these five years, that is, since Captain Cook's return from exploring, in the southern hemisphere, what was not there. Who knows, were our philosopher flourishing this day at the head of literature, but he would have retracted his old theory, so hastily deduced from the sudden occurrence of an apple's fall (a fruit of perversion,) and would have ascribed fixation and centricity to some object or other in our own system, perhaps, to the *earth*?

*Sir Isaac* honestly acknowledges, that he explained the *phenomena* of the heavens and our sea by a power, which he considered the effect of an unknown cause. Consequently, his explanation must be by an *obscure mean*, sprung from an *obscurer*. Indeed, he faintly alludes to a cause that glimmered to him, which, says he, must be universally present through the whole frame of na-

ture, and whose force cannot be superceded by any other material or created cause. Observe here the fertility and acuteness of a great genius, that, in the last century, distantly hinted what mankind have very lately concluded to be *electricity*!

Numberless weighty arguments have been brought by many against *Sir Isaac*, tending to invalidate what is commonly called his *physical system*, especially that part of it, which endeavours to account for the appearances of nature; as to the other part, which consists in an acquaintance with the appearances themselves, it has been hitherto less controverted. The plan of deducing the knowledge of unknown things from what is known may be often fallacious to an extreme; analogy and probable supposition may go a great way to discover facts in many cases, but not in all. It is hard to determine how far the *phenomena*, which we are accustomed to see on earth, would hold or vary in the regions above. † The possibi-

---

† Toward creating an idea of universals, this theorist syllogizes in the following manner; respiration in a man and in a

lity, to be sure, of applying ideally the nature, geography &c. of this terraqueous globe to a million of other ideal masses of matter, is equally easy as to figure, that there are thousands of hills in the moon covered with sheep, and as many sea-creeks abounding with herring. There is nothing to hinder a bold imagination from comprehending both as existing, because, analogy embraces the first supposition in the gross as forcibly as the latter in the abstract. Let us beware, though all that exists is possible, yet all that is possible does not, however, exist.

---

*beast, the descent of stones in Europe and in America, the reflection of light in the earth and in the planets, take their rise from the same causes. The conclusive aim of this is to infer, that the phenomena of the planets and our earth are the same: as to any planetic reflection of solar light, it is no more probable than that the light of one candle is reflected by that of another. It would be, indeed, a bad way of drawing conclusions to say: a man respire, a beast respire, therefor, a beast is a man; a stone falls in Europe in the same way one falls in America, therefor, Europe is America: the earth is a body, a star is a body, therefor, a star is an earth reflecting light.*



Sir Isaac was a person, who unquestionably distanced others in ingenuity and reputable abilities; he was an accurate and profound mathematician, whose wish was to unravel and reduce matters of doubt to perspicuity and demonstration. This resolution was laudable and noble in the highest sense, yet, espousing one single and bare quality or law as a key-stone to the whole œconomy and arrangement of the universe; solving and accounting for every phenomenon in nature by that principle alone, which he himself wavers about, at one time reckoning it the *first* of causes, and at another time the *effect* of some cause or other, concerning which he could not frame so much as an *hypothesis*, † placed his principle and scheme

---

† This learned knight's fondness to geometry appears to be of a piece with that of Doctor Mead, who imagined, that the causes of diseases might be investigated and their specific remedies discovered by mean of geometry. The algebraic and geometrical enthusiasm of those days made a famous French mathematician (whose name is presently not in recollection with me) say, that it was the business of every mathematician to find his way to heaven in a straight line.

at their outset in a doubtful point of view. By his mode of philosophizing, gravity actuated and effected every thing in the heavens and upon earth; levity, whether an opposite quality or an extreme modification of gravity, was never alluded to, nor called in; though a down or pile of chaff, raising itself apparently from the ground, and moving to and fro through the air, ought to command attention fully as soon as the fall of an apple from a tree. Principles of action and re-action, attraction and repulsion, inertness and mobility, centripetal and centrifugal qualities, powers of union, disunion, elasticity, transmutation, multiplication &c. among many other principles, qualities and properties, might be pointed out universal powers or laws of nature with equal success as gravity.

This theorist's chief agent he considered by much too universal and potent; *gravity* the most sluggish and inanimate quality in nature, ill became the appointment of being her prime minister. He, upon this occasion, judged it requisite to use a grammatical trope, viz. in the indiscriminate ac-

ception of *attraction* and *gravity*; thenceforth, the two words came to be considered expressive of the same thing. An ambiguous or equivocal style seldom fails to create jealousy and mistrust; provided the word *gravity* had the same significance affixed to it at the end of the last age that it has now, or if that quality be the very same now it was then, we are to take it in the following and no other sense; namely, the intrinsic weight or heaviness which arises circumstantially from the quantity and texture of any body, contained under the same bulk, whose tendency is invariably downwards with or without an external cause. Whereas, *attraction* denotes the mutual or confluent course of bodies, by whatever cause or in whatever direction they are inflected, impelled, drawn, or otherwise brought into congress, and which bodies may again recede, on a removal or diminution of the combining cause, in any direction as well as downwards.

*Sir Isaac's* demonstrations generally appear rather too hypothetic and arbitrary. He or no one else ever knew, and probably never shall know the

precise degree of rarefaction and bulk of the sun or planets. Consequently, any consideration or computation to show what their comparative tenuity, gravity, &c. may be to the earth, just as if a person had them essayed in a furnace, cannot but appear very unsatisfactory. At the same time, we are left in the dark how the disagreement of that property, thought of by him, can be accounted for between the exteriour planets, which are supposed to be great earths too, and our earth, particularly Jupiter and Saturn, which must be more dense as being at a greater distance from the sun and in a colder region; by virtue of the solar rarefaction, our earth should have been certainly considered less dense than those bodies; *Sir Isaac* reckons them, notwithstanding, much rarer. For this supposition he has not assigned any natural cause, but, like many other philosophers, referred it to the will of the Deity, because it could not be mathematically digested within the limits of his system.

It was a charge brought by *Sir Isaac* against the Cartesian vortical-theory, that it was unphilo-



sophical, and nothing else than a blind search or fishing for a true principle, and in fact but begging the question. This imputation, according to any view I can take of the matter, seems equally applicable to the *hypothesis* of universal gravitation. If the fixed stars are supposed to be suns, which, accompanied by their respective systems of planets, comets, &c. gravitate towards one common centre, which may be some object or other, that is actually at rest in the remote regions of absolute space, but impossible for us to know. How comes he, who broke the ice to the advocates of such universal commotions to reject one particular vortical-scheme? By his, the whirl and stir are prodigiously increased; pursuing the disquisition according to his view, every object, throughout each imaginable system or universe, as well as this, would appear as if upon wings, and scampering down, up, and about, just as if they were agitated by whirl-winds and eddies, suppose we grant, that they are not in distinct Cartesian-vortices.

As to what is considered a base to the mathe-

matical part of the Newtonian philosophy. Mathematicians assert that matter is divisible *ad infinitum*, therefor, they deny that we can come to an end of any infinite series; consequently, the word *ultimate* used by Sir Isaac wants a meaning; hence, his first position in the science of fluxions must be erroneous. Thus, suppose two quantities A and B, the one containing half a pound, and the other a third part of one; let both be continually divided by two, and though the proportion of the one to the other does not vary, yet the difference between them perpetually diminishes, as well as the quantities themselves, till they at last become less than any assignable quantity; notwithstanding, the difference will not totally cease, nor the quantities have an exact coincidence. Bodies, it is certain, become evanescent divisible, and thus have their limits as also nascent quantities have, in respect to human calculation. The most that can be said on this subject is, that so long as matter is liable to the cognizance of our eye-sight, and other senses, we can talk intelligibly about it, but when its parts become too

small or too great to be comprehended by them, we are then left altogether in the dark.

If the friction among the parts of a body could be removed, it would not require greater force to move a tun-weight than one grain of sand, says *Sir Isaac*. This difficulty he supposes to proceed from a quality of inactivity, which he considers again to be the innate force of matter, and whose exercise is both *resistance* and *impulse*. How contradictory is this not only in itself, but likewise to another position of the same system, where it is affirmed, that by the law of gravity, all parts of revolving bodies endeavour to recede from the axis of motion or centre, and the strong effort of a body moving forward arises from the joint efforts of all its parts! Here, it would be very irreconcilable to say, that the centripetal force of the minute parts of a stone, lying upon the ground, is what produces the small degree of stress, which a hand feels in raising it thence, and if then flung from a sling through the air, that it is the centrifugal force of its parts that revolves it onward.

How the projection of a planet, when pushed back to its apogee, after the action of the solar attraction ceases, can be maintained by its innate, that is, by an inert power, is not within the verge of probability, though, according to our theorist, a body maintains and keeps up every new state it acquires by its *inert force* only!

In regard to the revolutions of the celestial bodies, it is highly absurd, not to say impious, to speak of compounding a motion by a mixture of divine and created powers. If the Deity projects the planets in a right line, it is hardly probable, that a mediate or created quality should be constantly counteracting the Divine agency, in causing them to deviate from that line. If we suppose that He projects them at all, why may we not allow his being able to impel them in a circular, elliptical or diagonal direction as easily as in any other, or is He capable only to project bodies in a right line, as men can do?

The Newtonian way of explaining the motion



of the heavenly bodies, through a course descriptive of the diagonals of a parallelogram infinitely small, involves us in a contradiction no less than that of supposing the *radii* of a circle to be parallel to one another. By imagining the arches, delineated in the curvilinear movements of a body, to be exceedingly small, we may, indeed, think to get over with that difficulty, but this is only a mere deception. It is absolutely impossible, that the quality of gravity, acting in the manner it is usually found to do on earth, which is, to increase and prevail every moment after it first begins to act, can allow a body to persevere uniformly in a circular or any other kind of orbit, but must at last overcome the strongest projectile force imaginable. For, whatever force, motion or velocity receives a continual increment, will at last become unlimited and greater than any assignable quantity. On the other hand, if the power of gravity acts on a planet without intermission, this must perpetually increase its projectility; consequently the projection, receiving fresh additions, will be at length augmented beyond all

calculation, and the planet thereby will remove further and further from the centre.

Any supposition, that a planet, for example, our earth, should be like a spider knitting and looping an imaginary belt, obliquely round the central part of the sun's body, and backward and forward yearly, is equally inaccessible to the understanding as,

Were we to take an abstract view of our globe, and consider it to be a heavy round body, ten million of times heavier than a millstone; and this body to have been, during 5790 years, that is to say, since the creation of the world, describing diagonal lines and angles, as it were, by a mathematician's scale and compass, without deviating all the while from the boundaries of the ecliptic. †

All parts of revolving bodies, according to our

---

† *The ecliptic, between where it forms the greatest angle, at north or south, with the equinoctial line, does not exceed 1410 geographic miles; and the sun is a globe, whose diameter is said to be 890,000 English miles.*

philosopher's positions, endeavour to recede from their *axes* of motion. This, perhaps, might very justly be observed of the compressible fluid elements, but any such motion must be entirely lost in the solid; for instance, provided a common grinding-stone, two or three feet in diameter, was turned about, it would be unreasonable to say, that a recession of its particles from the *axis* took place, through the internal parts; any centrifugal exertion, then manifested, must arise from the general motion only, which the stone, as a whole, produces, and to be much the same as that of a hollow glass-globe, of the same diameter, moved with an equal degree of velocity.

If we are to suppose, with several great and wise philosophers, that the earth is like a shell, covering an immense vacuity, and supporting itself upon the same principles and mechanism, by which an arched cavern or vault is constructed, whose thickness does not exceed *five* miles, † nor perhaps so

---

† *English measure, viz. 1760 yards in a mile, is always to be understood where geographic is not mentioned.*

much, reckoning from the utmost point of the greatest prominence on earth. † Now, if this terra-queous globular-shell revolves daily upon its *axis*, and the atoms of its whole matter exert a centrifu-

---

† Nothing, perhaps, turns out oftner a subject of debate than the height of mountains. The remarkable disagreement in people's calculations concerning this matter, diminishes the credit of every assertion, and will oblige us to conclude, that all methods hitherto invented, including the specious art of trigonometry, are insufficient to fix upon the exact altitude of a mountain, and far less of a celestial body.

Varenius for instance says, that the peak of Teneriffe is 19,800 feet high, Heberdeen makes it only 15,396 feet, while Fuille reduces it to no more than 13,128 feet. Add to these dubious reports the frequented mount *Ætna's* unsettled measurement: the latest and most ingenious travellers vary egregiously in their accounts of it; some make it twelve, others eight, some again call it six, others four miles, while Sir William Hamilton and Mr. Brydone, who ascended to the very summit, reduce its pretended height to about two miles only. Some insist that there is, perhaps,



gal force, the aggregate power of the whole must be enormous, and by much oversufficient to resist and repel the centripetal force of every body upon the surface, animate and inanimate, of whatever

---

*no mountain on earth, whose perpendicular altitude above the sea-level exceeds two miles; how contrary is such an opinion to what others relate of one particular peak of the Alps named mont Blane, which they declare is above 800 feet higher than mount Ætna would be with Vesuvius placed on its top.*

*It has been invariably a decided opinion with me as to this matter, that there are many mountains, whose summits are little short of three miles above the sea. This being at least supposed, the greatest depth of the ocean, in the next place, is computed by most naturalists not to surpass half a mile: the phenomena of new islands, thrown up frequently from its bottom by the force of subterraneous fire or steam, and of others swallowed up in its bosom, show that the sea is perhaps far more shallow than is usually supposed.*

*Says Sir William Hamilton, if I may be allowed to compare small things with great, I imagine, the*

figure or size, though equal to the once existing huge tower of Babel. In such unmatched encounter of forces, a check and overthrow would be given, in one moment, to any tendency move-

---

*subterraneous fires do work under the bottom of the sea as moles in a field, here and there throwing up a hillock.*

*If the red sea was not shallow, and of less depth than we are ideally ready to ascribe to every sea; how could the Israelites, with Moses at their head, be able to descend the precipice of the Egyptian shore at once, and again ascend the Arabian banks on the opposite side with so much ease? Or how could Pharaoh's whole infantry, cavalry, chariots and other heavy carriages follow so expeditiously, unless that sea was nearly fordable before? It is not upon record, that its bottom rose up præternaturally, to serve as a causeway or raft, nor that, in imitation of human expedients, a temporary bridge was thrown over the channel.*

*Whenever a mound emerges out of the deep, we may suppose, the pit it leaves below to correspond in depth nearly with the height of the waters above its brim, consequently, the sounding of the sea over any unnatural*

able atoms could have to maintain either a centre of gravity, or centripetal position upon the outside of this globe; suppose, every square inch of terrestrial matter should have 15 pounds of atmospheric pressure on it.

---

chasm of this kind may then perhaps amount to 1760 yards. Now, it is presumable, that from the bottom of the chasm inwards to the concave side of the terrestrial shell, the arch does not exceed other 1760 yards in thickness; that is to say, the stratum blown away to the one left behind may be in the proportion of one to two. If the thickness of the standing arch was more, it would follow, that the electric fluid, in its passage from the concave to the convex side of the terrestrial shell, when sometimes setting through in strong torrents, and while the resistance behind is insurmountable, in that case might perhaps accumulate, or rather be thrown into convulsive motion, at a much deeper distance than half a mile below the bottom of the sea; the result of this would be, the projection of a hill instead of a flat island now and then out of the waters. Besides, it is more natural to conclude, that the electric fire, in its circulation, should have to penetrate, from our atmosphere to the terrestrial cavity and vice versa, only through a solid medium from

The Newtonian doctrine concerning the motion of comets is equally unintelligible and inconceivable, which urges that they are revolving in very eccentric *ellipses*, on account of their having got but a weak degree of projection only at first, &c.

Here is a defenceless position, not tenable upon the principles of mechanics nor tactics; it forfeits the smallest claim to credit, that the comets, supposed by *Sir Isaac* to be great bodies of earth like the planets, such big and unwieldy masses, after being

---

*one to five miles, which it can do with more freedom and ease, than through a solid crust of twice or thrice that thickness. Hence, a right line, drawn from the top of the greatest prominence of the earth to a diametrical point on the inside, cannot perhaps be far above or below five miles.*

*Some of the ancients compared the structure of the earth to that of a drum, which instrument though now made in a cylindrical form, yet might have been fashioned globularly in old times.*



drawn by the sun with a velocity of 880,000 miles in one hour, when they have at last come almost to touch him, should then fly off from his body, on the other side, with the same swiftness with which they approach, and that too by the power of a new motion which his attraction occasions! No doubt in bodies moving in curves round a fixed centre, as the centripetal motion increases, the centrifugal one should increase likewise. But, how this last motion, which is only generated by the former, should at last get the better of the very power that produces it, and at the very nick of time too that power has acquired its utmost force and energy, is quite incomprehensible. It would be the only instance known, wherein the effect increasing regularly with the cause, at last, whilst the cause is still acting with full and redoubled vigour, the effect entirely gets the better and leaves it in the lurch; for the body attracted is at last carried away with great velocity from the attracting body. By what power is it carried away? Why, our philosopher says, by the very power of attraction, which has now become a new quality superiour to itself in strength,

namely, the centrifugal force. Here, two opposite forces are fancied to be getting the mastery alternately of one another; the centripetal quality overcomes the centrifugal at the very time the action of the former is least, that is to say, when a comet is at its greatest distance from the sun, and the latter gets the better of the centripetal quality or gravity, at the very time its action is greatest, when the comet is at its nearest point to him.

*Sir Isaac* asserts, that the sun is continually revolving on his *axis*, and in progressive motion, perhaps, gravitating round some distant centre or other. Hence, sprung the notion of a plurality of worlds; our system having directly or indirectly any connection or participation with others, allowing them to co-exist, should be disavowed as a superfluous thought, repugnant to reason, unwarranted by scripture, and without an object, so far as has been yet descried by the human eye. Be this as it may, acknowledging perpetual motion in the sun is a proposition we should all agree with *Sir Isaac* in, and another circumstance that should receive our chearful assent is, his being the circum-

volving attendant of some centre or other. This centric body, however, we ought to bring home and consider to be the *earth*, and not any foreign object, supposed to be in a quiescent state somewhere in the remote regions of the fixed stars or far beyond them.

---

#### SECTION IV.

*The mechanical or Hutchinsonian system.—Reflections upon the Newtonian philosophy.*

**M**R. *Hutchinson*, who may be said to have been the rival of *Sir Isaac Newton* in astronomical aims and pursuits, could never muster so much patience and passiveness as were requisite to listen to the grand principle, which the latter had proposed to establish the universal and principal law of nature. This great man, the dignity and justness of many of whose sentiments have been much overlooked, asserted that the motions of the celestial bodies entirely depend upon the action of the sun, which consists in the emission of his light.

As we see, says he, that no fire can be preserved on earth without an influx of air, so it is reasonable to think, that the sun himself cannot be supported without the influx of a stream of air from every side. But the air, by which the sun's heat and light are preserved is of a purer nature than what we breathe, being perfectly destitute of watery or other vapours, with which our atmosphere is always loaded. The matter of which fire, light and air are composed is ultimately the same; the only difference we perceive is, that when this ethereal matter appears to us as fire or light, it acts with violence, issuing as it were from a centre to the circumference, but as air it acts more mildly, coming seemingly from a circumference to the centre. The reason of this apparent mildness in the action of air, in comparison with that of fire or light, is owing altogether to the grossness of the particles of the former, which renders its action less sensible; like a push with the head of a pin, which is less felt than a thrust with the point, though the one be given with no more force than the other.



*Henly, Cavallo* and many other men of distinction in the learned world never were of any other opinion, than that the electric fluid is a modification of the element of fire. But happily, the sameness of this fluid and the thunder flame has been abundantly proved between 30 and 40 years ago, by the inquiries and experiments of the deservedly celebrated philosopher *Dr. Franklin* of Philadelphia. About the very same time in which his discovery was made, it was put to the test and succeeded in a capital experiment made by an ingenious private-gentleman in France, and came afterwards to be confirmed and ascertained in an endless series of trials, made by other persons of invention and genius belonging to different nations.

The period, in which those discoveries and decisions were made, may give a date to the irrefragable refutation and final overthrow and wreck of the Newtonian physical system, to all intents and purposes. Nay, even before then, *Hutchinson's* first and fundamental principle was, that elementary fire is sent forth as such from the sun into the planetary regions and beyond them, where it

is converted into a different substance, whether air or electric fire, no matter which.

The chief created agents, assumed by our present philosopher, were fire, light and air. These elementary powers and qualities have no doubt a considerable share in the operations of nature, but unless the manner in which they operate be explained, our knowledge is not at all increased, for we might as well have contented ourselves with the Newtonian *gravity*, or the *occult qualities* of *Aristotle*. In fact, an evident deficiency of active principles is observable in all the theories of the world hitherto devised, which occasions a constant search after others, that, by their superiour activity, may be able to fill up the many blanks that necessarily appear in the system.

Modern discoveries in *electricity* seem to alter the form of every theory, that had been fabricated of old with excessive industry by various writers, in order to explain the great *phenomena* of nature, and this may be observed in general with a partial exception in favour of the mechanical scheme,

We must make ourselves sensible how one part of matter acts upon another, so as to produce the effect we wish to clear up; the demonstration of an effect again, arising from a material cause, should be attempted upon mechanical principles.

The motion of the celestial bodies can be more rationally accounted for upon principles of electricity. Thus, it rather appears, after the sun, as an inexhaustible electric body, has once charged the objects which he attracts with his own fiery matter, that then, by degrees, his attractive influence upon them ceases, till he is at last even repelled by them, and that attraction, like what we also observe in electricity, does not recommence between them till the electric fluid, imbibed by the repelling bodies or zones, is dispelled, when they are again drawn towards him, and so on alternately. We are to admit no more causes of natural things, than what are sufficient to explain their *phenomena* agreeably to the laws of mechanism. It is not admissible upon any authority whatsoever, that a body flying off from another, some thousands of miles in one minute, should, during that very time,

be violently drawn towards the latter body, or that it is by virtue of attraction it is flying off.

Had the electric system, and the power of repulsion, as well as attraction, been known and established in the last age, there is little doubt but the poring and searching genius of the eminent *Newton* would have called them to his aid, and, consequently, have accounted in a more satisfactory manner for many of the great appearances of the heavens, the earth and the sea.

There is no body that evidently possesses the power of attraction, which may not in certain circumstances likewise possess the power of repulsion; the magnet, tourmalin, amber, glass and every other electrical substance exhibit instances to prove this. Now, by strict analogy, as we find the sun so powerfully endowed with attraction, why may we not likewise suppose him to be possessed of repulsion? Indeed, this very power is confessed by the Newtonians to reside in him to a very great degree; for, they assure us, that he repels the rays of light with such prodigious force that



they fly upwards of 95 millions of miles in seven or eight minutes. Therefor, why should we confine solar repulsion to the rays of light only, as they may be, in a particular view, considered material, may not other matter brought near his body be affected in the same way? There is no doubt but the sun is the fountain of electricity as well as of heat and light, consequently, he must repel by mean of his electric as readily as attract by his gravitating power; hence, the law of gravity must be either an alternate effect or operation of the electrical power, or it must be perpetually interrupted by it.

*Sir Isaac*, in his definition of matter, incurs the charge of contradicting himself; at one time he affirms that matter is divisible without end, at another time he retracts this opinion and informs us, agreeably to the atomic doctrine, that it appears probable, the Creator had formed matter originally in solid, maffy and impenetrable particles, endowed with various powers of attraction and repulsion. The diversity of those opinions disconcerted his followers not a little, but their em-

barassment further swelled from his disagreement with himself, in the illustration of the nature of the attractive and repulsive forces. Their leader expessed himself in two different ways concerning this question; in his *Principles*, he positively maintains that they are owing to a cause which is not material, and in his *Queries*, he supposes they may be the effect of some subtile matter, called by him *ether*.

If these powers are actually immaterial, they must, therefor, be occasioned by the agency of spiritual beings, created or uncreated; if created, we run with the ancient heathens into the notion, that the world is governed by demons or subordinate intelligences; hence, an easy transition can be made to polytheism. If attraction and repulsion are supposed to be the immediate actions of the Deity himself, we run again into the doctrine of making him the soul of the world. This last *hypothesis* has been strenuously supported by *Baxter*, in his treatise on the immateriality of the human soul; and even later writers of character have espoused the opinion of immaterial powers to such

a degree, that if we believe them, the whole world consist of nothing else but attractions and repulsions mixed with physical points.

Certain other philosophers of the Newtonian sect, sensible of the insufficiency of attraction and repulsion to solve and explain all *phenomena*, in order to take their distress out of the way, were obliged to call in the action of the mind to their assistance.

*Leibnitz* and several more learned men upon the continent of Europe, at the very first appearance of the Newtonian philosophy, spurned and objected to the principle of *universal gravity*, considering it a downright absurdity, at best nothing but an unknown and abstruse power, no better than the occult qualities formerly inculcated by the Aristotelians, or another way of expressing ignorance. If attraction is the effect of any natural cause, such cause must be material, therefor, it can be regarded at most only as a partial, but never as an absolute and *sine qua non* law.

*Maupertius, Desaguliers* and some other moderate adherents to the persuasion of universal gravity acknowledge, that they never understood attraction to signify more than the bare effect or action of some cause, which, though not yet discovered, seemed to be settled by the great Creator as the first of second causes.

*Friend*, a very steady follower of *Sir Isaac*, does not deny his own belief, that attraction would always remain hid.

*Cotes*, another inflexible friend of the philosopher in question, declares, that the cause of gravity is occult and not yet discovered, but this occult cause is certainly the most simple of all causes, beyond which we cannot penetrate, and when we are arrived at it, we can go no further; therefore, no mechanical account or explanation of the most simple of all causes is to be expected or given.

*Sir John Pringle*, in his discourse upon the attraction of mountains, affirms that gravity has been long confessed by *The Royal Society* to be a



primary quality impressed by the Creator on all matter, whether of the earth or the heavens, whether at rest or in motion. Hence, their and his views of gravity seem to differ prodigiously from the opinion and line of argument assumed by *Maupertius*, *Desaguliers*, *Friend*, *Cotes* and even *Sir Isaac* himself. *Sir John* cuts short the matter, and says, gravity is a primary quality, without a material cause.

If with *Ferguson* we call it a law impressed originally on all matter; here is no difference, except merely between the phrase of an occult law and an occult quality.

If with *Baxter* and others we suppose, that attraction is the immediate operation of God, then the occultation is not only infinitely increased, but we have another inconvenience to battle with, and that is, to determine, whether or not the hands of the Deity are tied up from doing any thing in this world but by the mean of attraction, and if He is chargeable with doing evil by it as well as good.

Besides the foregoing objections to the principle and doctrine of attraction in general, it is in particular demonstrably inapplicable to the common *phenomena* of falling bodies, as the definition given elsewhere of this quality abundantly explains.

*Moses*, who had been educated in all the astronomical learning of the Egyptians, reduces the whole celestial host to three orders *viz.* 1. Sun, 2. Moon, 3. Stars.

*Sir Isaac Newton* takes only a contracted and partial view of the heavenly objects, and those that come within his observation he divides to five classes, *viz.* 1. Sun. 2. Six primary planets, among which our earth is reckoned. 3. Ten secondary planets, in which our moon is included. 4. Twenty one comets; † the periods of three of which are only known to us with any degree of

---

† How repugnant is this to what *Cassini* advances, which is, that there is a tract in the heavens peculiarly occupied by comets, and broad as the solar zodiac.

certainty. 5. Fixed stars. In whole 38 bodies beside the fixed stars, which appear thin sown. In clear and serene nights, when the sky is seen magnificently lined over with stars, some more than others may be observed to twinkle and scintillate, these alone are called fixed stars. Now, it may be very opportunely asked, what sort of things are the rest of the heavenly bodies within our sight? *Flamsteed* found 3000 of them about 80 years ago, and there have been, perhaps, as many more discovered since, by the help of spy-glasses in the hands of the contemplative.

Our philosopher thought that the fixed stars are subject to decay and waste away, but may be recruited again by the junction of comets, which sometimes fall into them; from those fresh supplies of fuel, old and consumptive stars, acquiring new splendour, may then pass for new ones. †

---

† *Those sideral phenomena moved Hipparchus to make a catalogue of the fixed stars, to see if this should help him to a discovery respecting the periods of their ebbing and flowing.*

If the fixed stars are officiating suns to other systems, whose nature is exhaustible, and whose repair depends on a reinforcement from comets; thence, we may conclude, considering the extraordinary excursions and rare visits of those erratic auxiliaries, many of the systematic suns must be so long without supplies of fiery matter, that their very existence will be often endangered; what, alas, becomes then of their inhabited planets?

I am out in my judgment, says *Sir Isaac*, if comets are not a sort of planets revolving in orbits, and returning into themselves with perpetual motion. Provided this *hypothesis* is granted, we must shiver at the consequence; the cometary inhabitants in that case would have miserable periods put to their existence now and then, when swallowed up by those immense fiery-globes or gulfs of suns, which they might accidentally fall in with. †

---

† *As to those bearded and long-tailed itinerants the comets, says Fontenelle, they seem to be ambassadors from distant great systems, who cry out upon their entrance to this, a new sun! a new sun! as sailors use to cry, land! land!*



## SECTION V.

*Electricity, seemingly, the chief power in the universe.*

*— The theory of the sun, &c.*

THE influence of the electric fluid is so general and prodigious, that in respect to this world, it may be said to have a degree of power bordering upon omnipotence. Though it is certain, since the creation of the world this fluid has had the same share in all the operations of nature, which it has just now, yet the disclosure of its action, and even of its existence, is, comparatively speaking, of a very late date, being not at all, or very imperfectly, known and understood by former generations.

Ere any reckoning of time commenced, complete three days prior to the creation of the sun and the inferior celestial-bodies, when the earth was a formless and unfinished humid-mass, before a firmament

was fixed between the waters, which were on the second day set apart above and below, and when nothing but extreme darkness brooded over the deep. Then, the Creator sent out a spirit, who moved over the surface of the waters, in order to animate and inspire nature. The first emanation of this commissioned spirit may naturally be supposed to have been, the superinduction of latent life into the embryo-world; and it appears, this was effected through the *medium* of the universally stimulating and vivifying element of *fire*, then introduced into the system; whose extraction again out of nature would leave the rest a perfect *caput mortuum* and useless dross.

Notwithstanding the infinite properties, which the fiery fluid originally possessed, it was still defective in one, it wanted a sufficient degree of brightness to illuminate a world. The Author of nature saw this, and at the close of the first night said, let there be light, or in other words let the fiery fluid, upon the wings of the elastic air, assume that quality more conspicuously, and it was immediately so. There were, thus, three days,

or rather three rounds of light, without a formed sun at all, during the creation-week; diurnal light may likewise exist after the sun shall be done away, and diurnal light might at this present time be in force independent of a sun.

The day-light, which preceded the formation of a sun, was very probably more uniform and placid than the one enjoyed now: the radiancy, ardent beaming and sparkling of the sun's rays may be intended to answer some other wise and good ends, but are by no means propitious or fostering to human life. A certainty of the comparative excellence of that light, which enlightened the earth in the beginning, can be deduced from *David's* testimony, namely, that the temperature of both the sun and moon had been actually qualified and modified for the benefit and well-fare of man. The original light was such as, when reviewed by the Efficient Power, pleased him fully, He was perfectly satisfied with its equable clearness and cheerfulness; lustre and warmth went then hand in hand, and their united and mild effusion was without vehemence, producing weather, perhaps,

not very unlike that which we have in this country a specimen of, in a serene and pleasant morning or evening during the hottest season, and when the sun is almost out of sight. The complete brightness, which the higher celestial zones of the fiery fluid wore during the first few days, had not the smallest need of any enlightening accession on the fourth day; any melioration or transformation then taking place was calculated to answer other solid intentions. In the first place, it was necessary to attach and give a determined and settled direction to those expanded zones of the genial principle of animated existence and heat, as well as to converge the thrice-cheerful light to one fixed point, which ranged before over less circumscribed bounds.

Upon the morning of the fourth day, an extraordinary luminous-globe, accordingly, appeared in the eastern quarter of the zodiac, whereby the fulgent zones, that had but lately enlivened the whole face of the universe, were attracted, regulated and brought to bear towards one defined and fixed point; which, as an inexhaustible centric



fountain of electricity, was in future times to disperse and collect again the fiery fluid alternately from and to itself. This glorious lamp, teeming with so much lustre and animation, and which may be considered an eye to the universe, seems to have been erected by the hand of the great Architect of the world chiefly in order to be a rendezvous and reservoir to the matter of heat and quality of light; an element and property almost constituting the being of nature.

This was not the sole object of the fourth day's work; the great and small lights, then kindled at large in the heavens, were to serve for signs and tokens to the inhabitants of the earth, whereby they can more accurately distinguish and enjoy the necessary vicissitudes of day and night; they were to serve as marks and directories for our observations in the prosecution of daily and stated worship, labour, journeys, and voyages, and various other duties and objects. Their movements, further, tend to afford both ends of the globe the experience of the grateful returns of the seasons, seed and harvest months;

and that mankind might be enabled by means of such pompous monuments, to keep calendars with some degree of accuracy, so as to subdivide their time into years, quarters or seasons, months, days and hours. Thenceforth, a reciprocity of lights commenced, the sun dealing out and conferring light on the earth by day, while in his absence, or by night, the moon furnishes a faint illumination of her own, to which the glittering of the stars makes a superb and lovely addition.

Further, in order to guard the human mind against being overawed, or continually overcast with dull and fullen impressions, arising from the languid and ghastly look of the moon, if floating across the heavens in loneliness, during the dusky and gloomy watches of the night; and so as no blank of any kind might occur to diminish or detract from the comfort as well as conveniency of man, the stars were superadded. In regard to those brilliant spangles, instead of being suns, with which the fable hemisphere is studded, belonging to other frames and schemes of creation, or peopled planets within our own; let us calmly restrain any

wantonness or impetuosity of the imagination in that way, and be satisfied that the whole of them are *electric bodies*, upon a par in character and denomination, and are so in every respect but in that of the *plus* and *minus*, as to the measure of their matter and motion. Hence, the whole heavenly objects, exclusive of the sun and moon, might in a general way be called luminaries or stars of the 1st, 2d, 3d, 4th, 5th, magnitude, &c. † We can come to some idea about this, from a very simple exhibition; suppose, a jar of quicksilver was hastily poured out upon the floor of a large

---

† A transient glance of a starry sky may bring one to an abstract remembrance of some spacious growing-wood, where old standards are to be seen, here and there, overtopping the neighbouring sprouting-thickets.

The Chinese, says Fontenelle, observe thousand planets, or, if you will, worlds falling every year from the sky into the sea with collisive noise, and others dissolving in the atmosphere. Our author saw many of those stellar worlds bursting like squibs in France: and we may in Scotland observe, during every starry night,

hall, this fluid mineral would be then observed, in globules of all sizes, running here and there in various directions, that tended to every point of the compass, and settling at last in particular orders, assemblages, squads, bands, rows, circles and groups; the whole, nevertheless, corresponding exactly in their look and quality, that is to say, as to colour, purity, fluidity, divisibility, specific gravity in the *ratio* of quantity, density, coldness, volatility by heat and so forth.

In like manner we may, perhaps, conclude that the astral substance is universally homogeneous, and the very same in quality with the electric fluid; portions of which, at the Divine command upon the fourth day of the creation-week, assuming, probably, distinct and globular forms, thenceforth, had been distributed and planted in compact, well defined and enlightening masses, along the

---

*night, dozens of bodies, nearly as splendid and well defined as Jupiter and its satellites, tumble down about our ears.*



milky way. † Where they are balanced and librated by a reciprocity of attractive and repulsive actions, arising from their power of electricity. Doeſt thou know the balancing of the clouds? Haſt thou, with God, ſpread out the ſky, which is ſtrong and as a molten looking-glaſs? *Job* was thus addreſſed by *Elibu*.

The arrangement of the ſtars took place, for ought we know to the contrary, principally, in order to garniſh and decorate the face of heaven, for the perſpection and benefit of man.

---

† The whiteneſs in the heavens called galaxy, ſays Fontenelle, is perhaps, an infinity of ſtars planted ſo thick, that their interſtices are not diſcernible. They are, uſing a common phraſe, an ant-hill of ſtars, and not unlike the Maldivy iſlands, that are interſected only by narrow channels of the ſea, over which men can jump; the planetary worlds of the galaxy may be ſo near, that their pigeons are, perhaps, trained to carry letters from the one to the other, as they do here and there at the Levant; and the adjacency of thoſe worlds may enable their inhabitants, alſo, to converſe and ſhake hands ſometimes with one another.

The Lord made man to have dominion over the works of his hands; He has put all things under his feet, says *David*. †

These statements cannot but contribute to our coming to a decision, that all celestial objects, or the outworks of the universe, to which the eye has access, are no more than subservient members and appendages of the earthly system. *Moses* says so, and it is not likely, any will call such authority as his to question; never one, at any time upon earth, had better opportunity to inform himself

† The stars were called *stellæ* by the Romans from the greek verb *στellaō* to ornament; when a few of them are closely collected, we ourselves call these constellations. The Greeks named them *ἀστέρα*; from the Hebrew substantive *שׁוֹמֵר* fire. They, as well as the sun and moon, were likewise very naturally called *sidera* by the Romans, from the verb *sido*, because all of them appeared to sit down in the western ocean from sun-set to sun-rise; precisely as gnats, placed on the axletree of a wheel, should see conspicuous spots on the concave side of the wheel moving from east to west.

concerning the secret constitution and outlines of nature. His Maker admitted him again and again into conference, and their ever memorable interview upon mount Sinai took up no shorter space of time than 40 days! This remarkable statesman and moralist, whose institutes and precepts were not of himself but of pure divine extraction, very probably obtained a fund of natural knowledge, as well as moral and political instruction, orally and *viva voce* from God himself. We have no reason to think, he was a man void of curiosity and an inquisitive turn of mind; wishing to behold the face of Him, who cannot be seen by mortal eyes, confirms this. Our sacred historian, at any rate, would not pointedly inform us, that the sun and moon were created in conjunction with the earth, designedly for signs, seasons and so on to its inhabitants, if it was otherwise. Why are we particularly told, how the fourth day of the creation-week was employed, if the sun and the rest of the heavenly host had existed before? That must have been a day, in which hardly any thing was finished, allowing its fellow-objects to be only unscreened to the earth on it.

The sun, who is, perhaps, no more than a consolidated and enlightned body, too, of exceedingly pure and genial electric-matter, formed and placed in a convenient situation in the regions above, during the course of the terrestrial creation and arrangement, of necessity must be considered one of the constituent parts of the immense contexture of the universe; intended for the uses and purposes already assigned, while the earth stands, but when, in the fullness of time, it shall be reduced to nothing, or entirely metamorphosed, it is then in like manner determined to annihilate him. The sun began with the earth, and will terminate with it; this of itself ought to be cogent and conclusive proofs, that the original purpose of his appointment was, to supply and fill up some vacancy in the system of the earth.

Provided the other 15 planets belonging to the solar system, as at times it is called, be established and furnished like this globe, for the reception and accommodation of rational inhabitants; pursuing the analogy, it may be well said, those worlds were finished off with far more dispatch than ours.



Passing by all human authority about this matter, let us couch all at once and submissively acquiesce in what the Creator himself twice wrote, and as often delivered out of his hand to *Moses*, namely, that in six days He the Lord made heaven, earth, sea and *whatever is in them*! Indeed, it would be very inconsiderate and rash in us to suppose that He, during the short time He was pleased to allot for our creation, should likewise be engaged in a multiplicity of other complicate and eccentric works at the very same instant.

Agreeably to *John's* allusion to the last display we will have of those heavenly bodies, at the universal dissolution of nature; the sun shall become black as sackcloth of hair and the moon shall appear as blood, the stars of heaven shall fall unto the earth, and the heaven will depart as a scroll, when it is rolled together. Here we are to take notice, it is not the terraqueous globe alone, but the whole universe, that is to be annihilated at the extermination of nature; the sun, moon and stars will join issue with it. If our earth, according to the opinion of many, is no more

than a mote in a corner of the visible creation, its reduction to nothing, let this fall out when it may, should be motely too. Why are the celestial bodies comprehended in its impending catastrophe, or made mention of and referred to at all, if they are eccentric and foreign schemes? Besides, as the planets are to tumble down upon the earth and expire with it at last, this necessarily must bring on a trial and examination concerning the merit and demerit of the moral conduct of their rational inhabitants, at the critical period we are to be standing pannels before Chriff's solemn tribunal. Those events surely, from analogy, should bid fair to be attended with superfluous tumult and confusion; it is true, the accumulation of judicial business at the end, and the erecting operations in the beginning might be reckoned of a piece.

The second Person of the Trinity, who then is to sit magnificent and supreme judge of all, foretold regarding the end; that immediately after the tribulation of those days, the sun shall be darkened, and the moon shall not give her light,

*the stars shall fall from heaven, and the powers of the heavens shall be shaken.* In other words, the fiery-fluid, presently constituting all the luminous orbs above our heads, and which gives law, or, as it is expressed in the book of *Job*, ordinances to the heavens, will then dissolve its amassments and relinquish its aerial inclosures, and in the way a single star is now frequently seen dropping from heaven about our feet, the whole celestial bodies shall at last dart down to complete the earth's ignition, leaving those orbs behind, now so glorious, then no better than apparitious clouds and grim spectres. The elements will melt away with fervent heat, and it is probable the fiery matter, after destroying and undoing all but itself, will finally even consume itself, or be translated. The world was driven from before the Lamb, and there was no place to receive it, says *John*.

Thou, Lord, the first Person of the Godhead thus addresses the second, according to *Paul*, hast laid the foundation of the earth, and the heavens are the works of thine hands; they shall all perish and wax old as doth a garment, and as a ves-

ture shalt thou fold them up, and they shall be changed. † Those, who are at any loss now where the centre of the world is, will then have it disclosed to them, when the out-posts and extreme detachments, as it were, will be ordered to fall in with the main body and join in the general issue.

Never was a weapon preferable to the Copernican scheme put into the hands of freethinkers, scripture-scoffers and infidels.

---

† *The sun, moon and stars, according to Zeno, Cleanthes and Chrysippus, shall, in common with the rest of the universe, perish by fire, caused by the power of fire, which is in all things, and which, after a long time consuming the moisture thereof, shall resolve every thing into itself. Thus, the opinion of the universal conflagration of the whole system at last was maintained, from the light of nature, by the first and most ancient of the sect of Stoic philosophers.*



## S E C T I O N VI.

*The same subject continued.*

PROVIDED the physical question, whether the sun is our systematic centre, following another centre, or only the chief satellite † in the train of the earth, had become a political subject of debate, we would undoubtedly appear more tenacious of our natural right. Upon this occasion, we would strain every nerve in arguing irresistibly and at great lengths, that his service was originally adjudged to us, and that his and our connection was so intimately interwoven, as to preclude the smallest claim of any foreign power whatsoever upon him.

The magnitude of the sun, as well as his proximity to the earth we are entirely ignorant of. Omnipotence might, by only saying, *let it be done,*

---

† *The commanding yeoman of the guard.*

cause a ball of condensed electric-fluid, one mile in diameter, to exhibit and produce the very same appearances and effects, which the sun does. Mark the promptitude and ascendant power of providence, that kept time and pace with the exigencies of mankind in other less momentous instances: namely, the meteor that pointed out a line of march to the Israelites, when retiring from *Pharaoh's* dominions, which, at the approach of their pursuers, veered about and covered the pursued's rear, always shining upon their encampment but darkening that of the Egyptians; the copious supplies of quails, manna and water dispensed in the barren and inhospitable deserts of Arabia, for the term of 40 years; the multiplication of the widow's oil, through the ostensible power of *Elisha*; the extraction of heat out of the highly inflamed furnace, impiously ordered by *Nebuchadnezzar* to cut off the steady *Shadrach* and his two companions; the transmutation of water into generous wine, upon a convivial occasion at Cana of Galilee; and the extension of a few loaves and fishes in the hungry wilderness of Bethsaida!

Miracles and supernatural agency are not to be laid aside, because some men may perhaps dislike them. Little or no incongruity appears, in the application and analogy of the casual and temporary displays of *might*, just now mentioned, to the somewhat parallel, though more permanent *phenomena* of the sun, moon and many other things; no contradiction is implied in either, so, both are equally easy to the Almighty. To him, natural and supernatural, perennial and ephemeral displays of power are alike, and He can make use of immaterial and uncreated power, when material and created second-means may happen to be deficient in producing and bringing to pass effects and events, agreeably to his sacred pleasure and inviolable purpose, either in the original establishment of any law of nature, or subsequent interference and superintendence otherwise thereof.

According to a calculation made by *Sir Isaac Newton*, the rarity of the air, at the height of 200 miles above the earth, bears the same proportion

to our atmosphere as 7500000000000 do to one. †

Again he says, at the height of one semidiameter of the earth, or 3985 miles off, reckoned from the earth's surface, the air is more rare than with us in far greater proportion, than the whole space within the orb of Saturn is to a spherical space of one inch in diameter. And, therefor, if a sphere of our air, about one inch in thickness, was equally rarefied with the air at the height of one semidiameter of the earth, from the earth's surface, it would fill all the regions of the planets to the apogee of the orbit of Saturn, and far beyond it.

If the first of these calculations is absolutely just, or nearly so, three very probable conjectures may be deduced thence, *viz.* respecting the distance of the sun from the earth, and the density and size of his body. 1. It is presumeable at once from

---

† *Princip. Book III. p. 231.*



this calculation, that air cannot be in a state of higher rarefaction than at the altitude of 200 miles; consequently, the rarefying cause must be present there. 2. If the air, occupying the intervening space between the sun and the earth be tapering, as it were, from a thin celestial-base of seventy-five millions of millions of feet to a condensed *apex* of one foot of atmosphere, such as is to be found near the surface of the terraqueous globe; then, we may mathematically conclude, provided a zone of our atmosphere, whose circumference and that of the sun corresponded, was placed where he is, we would see that zone, if any how rendered so luminous and beaming as he, equally visible as we see the sun; hence, his density does not perhaps much surpass that of the terrestrial atmosphere. 3. As to his exact size, the conformation of the eye can be of very little service to us with respect to objects, which are situated without the limits of distinct vision. An object will generally appear then more or less confused, according as it is more or less removed from those limits; this confusion assists the mind in judging of the distance of the object, it being al-

ways computed so much nearer or farther off, by how much the confusion prevails. But, this confusion has likewise its bounds, beyond which it can never extend, for when a body is placed at a certain distance from the eye, to which the breadth of the pupil bears no sensible proportion, the rays of light, which come from a point in that object and pass the pupil, or the object-end of a telescope, are so little diverging, that they may be considered as parallel; a picture then on the *retina* will not be sensibly more confused, though the body be removed to far greater distance. Thus, we do not judge of *distance* merely by the angle under which objects are seen, though their apparent magnitude decreases with the angle under which they are viewed, as has been always understood. It is also confessed, that it is only by custom and experience we come to form judgment both of magnitude and distance, and if the bulk of bodies be misapprehended, the idea of their distance will vary likewise.

*Bouguer* observes with much truth, that very great distances, and those that are considerably

nearer than they, make nearly the same impres-  
 sion on the eye. The precise distances, therefor,  
 of celestial bodies can never be ascertained; not-  
 withstanding the strong reliance people of the pre-  
 sent times have upon trigonometrical and, more  
 especially, telescopic assistance. If we amuse our-  
 selves with the *hypothesis* of the sun being only  
 200 miles distant from the earth, from a persua-  
 sion that, perhaps, the ultimately possible degree of  
 aerial tenuity is to be found there; though, by the  
 by, it is probable the vehemence of the sun's en-  
 tire heat is by no means capable to produce such  
 degree of dissipation, as is here supposed by Sir  
*Isaac*. If we listen to the supposition, however,  
 that he is so near the earth, that moment we  
 should concur in the reduction of his ideal size,  
 and acquiesce in a reasonable extension of his ap-  
 parent magnitude; for if the interveining *medium*,  
 between him and us, be of such exquisite tenuity,  
 as is imagined here, consequently, he will with  
 very little difference be equally near, in an opti-  
 cal sense, as if his walk had been but few leagues  
 beyond the boundary of our atmosphere.

In the course of common experience it is well known, when a person inclines to illuminate a room of 156 by 180 inches, or 13 by 15 feet, in dimension, it will be judged quite sufficient to place 24 candles in it, properly disposed, whose flames, had they been united, would form a column of 24 half inches or one foot. This blaze would abundantly enlighten the apartment, without kindling one of 156 by 180 inches in diameter. As therefor, we know there is never an area of above  $156\frac{1}{2}$  by 180 degrees of the earth illuminated by the sun at once †, it would be equally superfluous as in the above-mentioned pa-

---

† For example, the hemisphere of our globe opposed to that space of the heavens, which is between the east and the west cardinal points, and the part of the same hemisphere, which is between the arctic circle and the south pole, enjoys solar light only, when the sun is exactly in the south and north meridian zenith-line, at the winter solstice with us.

Were



rallel case, to apply a flame of  $156\frac{1}{2}$  by  $180$  degrees of solar substance to shine upon a district of the earth of the same extent. Let us not run the risk of being suspected *tacit* idolaters of the sun! To compare small things with great, the *phenomena*, which the light and heat of earthly fires produce, should excite our admiration proportionably as high as those which the light and heat of the sun do: to the same natural effects we must, so far as is possible, assign the same causes.

---

Were a person, whose time and other opportunities allow, to provide an artificial terraqueous-globe of any given size, as also, a globular glass-lamp, whose diameter to that of the globe may be in the proportion of one to eight, or of any other diameter which he finds answerable; and to hold this lamp, well illuminated, perpendicularly above the south tropical line, or in a fit situation to enlighten precisely the hemisphere from the south pole to the arctic-circle. If then, the distance between the lamp and globe is taken, the ratio of it to the diameter of the globe may go a great way to discover the distance between the earth and sun at the  
tropic

Astronomers compute, that the diametrical measure of the sun amounts to 890000 miles, and his being of a globular figure is a circumstance universally acknowledged. Now, one of his hemispheres, conformably to such diameter, would make a half-spherical surface of 1335000 miles over every way. Can any one coolly believe, that such an immense face of flame would be opposed to an *area* of the earth, not exceeding 10800 by 9390 geographic miles †, in order to throw light upon the same? As little we can depend upon the assertion, that the sun is 95173000 miles distant from the earth. Experience without the smallest consultation with reason, is enough to show, that the nearer the source of heat and light is to any object, the influence of

---

*tropic of Capricorn, as well as what the very magnitude of the sun himself is.*

*The exact diameter of the earth is and shall be undetermined, till the longitude is found out, the computation of 7970 miles is, like many other things, ideal.*

† 60 of which are equal to  $69\frac{1}{2}$  English miles.

those qualities will be the quicker and more efficaciously communicated to it. For instance, if there was occasion for erecting lamps to light a street in Gibraltar, whether an adjacent place, or the top of one of the Pyrenean mountains, was the most eligible situation to have those lamps fixed up, required no deep deliberation to determine.

If these observations regarding the distance, density and magnitude of the sun, come short of established axioms, the statements and propositions now made must remain problematical; though the certainty is approached, that he is not at the vast distance which we apprehend, that in substance he is, perhaps, a ball of compact electric-fluid, or an embodied and luminous sphere of pure elementary-fire, and far nearer his apparent size than of the enormous bigness which we are apt to affix ideally to him.

By the Mosaic account, the heavens and all their host were formed at the same instant of time, in which the earth and the fullness thereof were

finished. By revelation we come to know in like manner, that they shall all perish indiscriminately together at last, or be subjected to an *analysis*, which cannot at present be seen into by us; the creation, duration and fall of the whole, however, are precisely to correspond.

*David* speaks in the clearest language on the subject of solar motion; the Creator, says he, in the beginning did set a tent or canopy for the sun, whose appearance therein, he beautifully adds, is majestic and pompous; not unlike the appearance of a bridegroom stepping forth with comeliness and gaiety from his chamber, or like that of an athletic youth, starting with ardency from the goal to run in the race; thus, the sun sets out from one end of the heavens circling to the same end again. To this he adds, that the moon is appointed for seasons, and the sun knoweth his going down.

*Solomon* is known to have been an universal naturalist, whose wisdom, knowledge and largeness of rational sentiments excelled all the sages of the



East; he treated of the vegetable world, from the cedar-tree of Lebanon down to the hyssop that springeth out of the wall, and wrote also of beasts, fowls, reptiles and fishes; he tells us too, that the sun ariseth and goeth down, and hasteth to the place where he arose.

In the books of *Kings* and *Isaiab*, the sun is said to have returned 10 degrees backward in one of those places of sacred writ, and his shadow to have done so in another, in the case of *Hezekiah*.

*Moses* relates concerning the overthrow of the profligate cities of the plain, that when *Lot* was entering Zoar, the sun was risen upon the earth. Why might not the historian express himself otherwise and say, Zoar had just entered the solar light at that particular time?

*Josbua*, a general, and the only one, who ever had the honour to fight immediately under the orders of heaven, is likewise reprehensible for praying to his Divine Commander to stop the sun, an immovable body, and the moon a moveable one,

in their career, until he obtained complete victory over the Amorites. It was just as easy to pray, that the earth should halt in its motion and stand still with its satellite in the same positions, in which they then stood as to the sun, did he actually believe the motion, which we perceive in him, belonged to the earth. Besides, it was extremely confused to petition, that a body, which was not in motion at all, should be stopped, and in the same request to join another body which is in actual motion. The answer made to his entreaty announces motion to both, in the most direct and unequivocal sense, the sun stood still over Gibeon and the moon over the valley of Ajalon. † Now, where have we any authority to believe, that *Copernicus* excelled all those heavenly instructed men in natural knowledge? We know perfectly well, who it was that dictated to them, but who it was that directed the opinion of the canon of Thorn we are not able to say.

---

† *The Turks, Persians, Arabs and other nations to this day recite the poems of Sady. Who, describing the*

Let us pause here for a little, and attend to no argument whatever, in behalf or against the opinion of the sun being in motion round the earth, or his being rather a centre to it and the other objects of this system; as little let us mind, whether the earth be revolving round the moon, or if the moon is in circulation around it; but refer the solution of these nice questions simply to the discernment of our own senses and faculties. Then suppose some spectator or other, entirely unbiassed and unwedded to any one opinion more than another, had told us equally unprejudiced with himself as to those matters, that it is the earth which is moving round the two great celestial bodies, notwithstanding their apparent motions, we might perhaps credit him, and charge our mistake to the

*the grandeur of the Deity in one of them, thus proceeds;*

From east to west He drives the rapid sun;  
He takes two drops of water; This forms man;  
That, the translucent pearl in the deep: &c.

score of some defect in our own senses and judgment. If another suggested, that both those luminaries moved round the earth, in the very way our senses and judgment, unperplexed by sophistry, should guide us, we would, perhaps, give ear to such an assertion too. But if a third person confuted both the foregoing assertions and urged, that one of those bodies rather was actually at rest, and a centre to all visible objects, and the other only an attendant upon the earth, and always in rapid motion round it; surely, after considering his view respectively as to both bodies, and contrasting it with their similar daily motions, from east to west, we would be ready to conclude this man had widely and notoriously gainstayed himself.

It has been called a preposterous and turgid thought to suppose, that the heavens with all the luminaries therein are revolving round the earth every 24 hours. The Copernican system itself admits of the moon's diurnal revolution round it; what is to hinder any other systemist, with equal address and success, to ascribe similar and as quick motion to the sun? The stars too should appear just



as nimble to run in the same race, and this no doubt they do, according to their respective periods; therefor, the whole difference between the Pole's system and the Egyptian's is in fact wholly this; whether the sun or the earth should get preference to be the world's centre. Some astronomers, indeed, have given a marvellous air of sanction to the first of these *hypotheses*, when they say, that the body of the sun is a prodigious globe of fire, whose diameter is seven or eight times greater than that of all the planets, though united into one mass. The quantity of matter in the sun, says Sir *Isaac*, is to the quantity of matter in Saturn, as 3021 to one. This is a big thought, it is of such magnitude, that it is by no means surprising, why mankind have not been fond of tampering with the subject it belongs to!

It is equally inconsistent that the earth and the other planets, which, according to the opinion of the theorist just now mentioned, are very ponderous and sluggish bodies, should be all skipping and dancing about the sun, as if a painter was to reverse his usual method of drawing, by fixing

his pencil on a table, and then execute draughts and lineaments by moving the canvas backwards and forwards over the pencil.

The earth's moving with such impetuous strides and turns, as is imagined by some, in order to receive the influence and benefit of the sun, should appear just as awkward, as if any person held a heavy geographical-globe in one hand, and a slight burning-taper in the other, and then, instead of moving the latter round, in order to convey its splendour upon particular parts of the globe, he was to move the last voluminous and opaque body round the taper.

## SECTION VII.

*Hypotheses regarding the positions and phases of the earth, sun, moon, &c.*

**I**N order to conceive the relative positions of the capital objects in the worldly system, though but in a very faint and imperfect manner, any person of curiosity may, at his leisure, get

ready something like the following oratory-constructure, and afterwards, have it suspended in his library, to see if the expedient, however weak, can give some degree of steadiness to his wandering and desultory ideas, when engaged with the subject of astronomy.

Let a ball be made of cork or any other light substance, three inches in diameter, and painted green, with red equatorial and ecliptic lines; next, two other smaller balls are to be provided, the one measuring half an inch and the other a quarter in diameter, the larger of these to be painted red, and the least of an orange colour. Then, two slips of light blue paper, the one three inches broad and the other half an inch, are to be prepared in the form of girdles or rings; the circumference of the broad one amounting to three feet and nine inches, and that of the other to two feet and three inches. A piece of dark coloured and slender cord, or hair line, may be drawn through the axis of the green globe, which being knotted at the distance of three inches, introduce it the length of this knot

through the less ring, at half the breadth of the ring from the concave to the convex side; let the ligament be knotted over again at the distance of other three inches, and drawn as before through the larger paper-ring: lastly, the poles of the green ball being turned south and north, while the rings are swerved into an east and west direction, in this manner let the little apparade be cliked to the roof of the apartment. Equinoctial and ecliptic lines are to be, previously, scored along the concave side of the big ring; and about where these lines should begin to form an angle in the point of *Aries*, as it were, upon the interiour girdle, there, the orange-coloured ball is to be waxed, representing the moon; in the same way, the red ball is to be fixed where the equinoctial and ecliptic lines meet in the sign *Libra* upon the external girdle, prefiguring the sun.

Thus, the green globe serves to represent the earth, the orange-coloured one denotes the moon, and its ring an imaginary equinoctial-circle within the lunar zodiac, or the course through which



that changeable luminary performs her monthly revolution †; the red globe may put one in mind of the sun, and its girdle of the solar zodiac, through which his annual walk or great routine is made. Hundreds of greater and smaller spots, of yellow colour, may be likewise penciled over the insides of both paper-belts, in imitation of stars of every magnitude. Were a gnat placed upon any part of the green globe then, which was to look up to the zenith and about again towards the horizon, its prospect would, perhaps, nearly coincide with that of men upon the terraqueous globe. *Fontenelle*, about to unfold the structure of the universe to his *marchioness*, begins his demonstrations much to the above purpose.

By the Newtonian astronomy, celestial objects are reduced to two classes, viz. primaries and secondaries: or which may be considered rather

---

† The moon and planets are said to wander up and down over a space of eight degrees, or rather more, beyond each side of the ecliptic.

as electric bodies reciprocally influencing and influenced, the whole being liable, in particular situations, to be sensibly affected by the superiour attraction and repulsion of the sun and moon. Hence, we can comprehend how those mobile electric-balls, named planets, may be centres to less globules around them, and how they may be situated in the lunar rather than in more distant aerial-regions. The very same Power, who planted stars at greater distance from the earth, might as easily, and seemingly to better effect, settle companies and files of them in more concentric situations †. The fixed stars, which are ap-

---

† If the moon goes through her orbit in 27 days, 7 hours, 43 minutes and 4 seconds, at a mean rate, from any given fixed star to the same star again, as observations show; that fixed star must be in the boundary of a less circle than that described by the sun, for the moon takes 29 days, 12 hours, 44 minutes and  $3\frac{1}{10}$  seconds, to quadrate her lunation to the radii of the solar circle. Hence, can it not be absolutely concluded, that the fixed stars are nearer than the sun to the earth?

parently stationary, because neither their size nor motion are cognizable by the eye, further than that they are observed to keep generally at the same distances from one another, probably, are primaries also to their own adjacent little constellations, whose inferior size renders them still more imperceptible, and hardly visible, except when the sky is remarkably clear and free of clouds. Lastly, as to comets, they seem to be only highly charged electrics, not unlike rockets; from this circumstance they become more erratic than the rest of the stars, yet, they still have their periodical revolutions, and are subject to the laws of nature. The phenomenon of planets, fixed stars and comets becoming sometimes brighter and more enlarged than at other times, may be imputed to their fortuitous junction with wandering electric-balls, meteors, other comets, falling stars or such. From what is observed, it is easy to conceive, after a curvilinear impulse had been originally given to the sun, how this action might change afterwards into an energetic and electrical power, and continue ever since, carrying

him through his orbit round the earth. An oblique or spiral direction being superinduced to the curvilinear motion, an idea may be further formed, how, his diurnal circuits might be made first to the northward and again to the southward. In this way, his annual arising from his diurnal movements, and all the *phenomena* that follow, can be understood without recourse to ambiguity or fiction.

It will be allowed that the sun, when newly created, appeared in the eastern part of his orbit, whence he set out upon the morning of the fourth day towards the west; and, on that same evening, it is likely, the moon made her appearance in the east quarter of her orbit also, proceeding westward like the sun, but nearer the earth. The concise hint, which scripture gives of the geography of the country of Eden; into the possession and tenure of which mankind were introduced at first, gives us room to conclude, it might have been situated nearly about the 35th degree of north la-



titude and 40th degree of east longitude. † Consequently it is reasonable to suppose, the sun's walk for the first six months was vertical to the northern hemisphere, and that at first he appeared perpendicularly above the equator, or where the inhabitants of the northern end of the earth say he is at the vernal equinox. Whence, he began to make gradual advances towards

---

† *By the Mosaic narrative of the third day's creation, it does not appear, the vegetable world was then produced in the state of maturity, but only in a rudimental stage; there was neither sun nor moisture as yet, Moses observes, to bring on vegetation, nor any man to cultivate the ground.*

Dionysius of Alexandria, Julius Cæsar and Charlemaign with their doctors and astronomers, and Pope Gregory, to all of whom we are much indebted for their amendments and adjustments of the calendar, seem to have had in view, that it was seed-time in those regions of our globe, which lie about the 35th degree north latitude, at the time of the creation.

But,

the north pole, describing an oblique or spiral circle during every 24 hours until, after passing the signs *Aries*, *Taurus* and *Gemini*, he entered that of *Cancer*, where in respect to bounds it is said to be the north tropic, and as to the season, the summer solstice with us. At and from the tropic of *Cancer*, it should seem, by a cosmical

---

*But, why the janua or entrance of the year was fixed by them 80 days earlier than the vernal equinox must have been, probably, in order to fill up a cycle or round of time, the adaptment of which, perhaps, could not be otherwise husbanded with precision, nor an easy co-incidence in the diversified revolutions of the great heavenly-bodies hit upon, by any other method.*

*The climate in Eden was, immediately after the establishment of the sun, probably, not very different from what is experienced in a mild season about the 21st of March yearly at Madeira, the 21st of April at Venice, the 21st of May in the eastern part of Scotland, and about the 21st of June in the middlemost parts of Iceland.*

law then newly commencing †, that the sun was remanded to run over a retrograde course by the signs *Cancer*, *Leo* and *Virgo*, till he arrived again at the equinoctial line, when we say it is the autumnal equinox. Then, instead of reiterating the same aerial journey, he, when of six months standing, moved forwards to the southern hemisphere, by the signs *Libra*, *Scorpio* and *Sagittarius*, till he reached the south tropic, when the inhabitants of that end of the globe call it their summer solstice; at the end of nine months after his formation, he reverted his southern career and fell back from the tropic of *Capricorn* towards the equinoctial line by the signs *Capricornus*, *Aquarius* and *Pisces*, and at the end of the first year re-entered *Aries* again, when it was the second vernal equinox.

---

† Here it may be asked, why does the sun stop at the sign *Cancer* and move no further north? To wave this query, let it be first explained, why the torrid zone and no more of the earth keeps as it were in the sun's focus, during its whole supposed annual course?

The progressive motion of the sun, thus, seems to be in spiral curves. By the spiring of which curves, his place is changed a 365th part of the ecliptic every 24 hours; bending from the equinoctial line northwards from the 21st of March till the 22d of June, or during his northern declination, and from the 22d of June to the 23d of September, or during his ascension again to the equinoctial line, he re-doubles those spiral curves. From the 23d of September to the 22d of December, that is to say, during his southern declination, he continues circling towards the south, but from the 22d of December to the 21st of March, or during his ascension back to the line, he recurves his spires.

In such manner as if one held a cork-screw, whose handle was made of wood shaped like a wine pipe, and having three circular lines chalked on, in imitation of an equator and two tropics. Then, suppose a skein of thread was unfurled along this handle till 90 circumvolutions were made from the centric line to the imaginary north tropic; whence, other 90 wreathings were



regressively made to the middle line; the mid-line then being crossed, and the spiral turns of the thread still progressively continued till they amounted to 90 more, when the south tropic, as it were, was reached; and thence lastly, an equal quantity of spires to be duplicated back to the line which represents the equator. Now, the number of all the single and double windings of the thread made from tropic to tropic, so to speak, upon the handle would be 360, which correspond with the diurnal circuits of the sun, described every year round the earth to five and a quarter, and this difference arises only from diurnal fractions of solar motion, summed up at the year's end. Thus, the ambits of the sun, comparatively demonstrated above, which are performed upon one side or other of the equinoctial line in the zodiacal regions, can produce the vicissitudes of seasons, days and nights, as well as every other phenomenon that we are accustomed to take notice of, with similar and equal exactness and advantage, as could arise from an annual motion either of the earth or sun round each other, in the way the revolution of some one of them is presently imagined to be going on.

If we begin to observe the progress of the sun, for instance, after the beginning of March, we will find that he appears to rise almost every day sensibly more northward than he did the day before, to continue longer above the horizon, and to be more vertical at mid-day. This continues till towards the end of June, when he is observed to move backward in the same manner; and this retrograde motion of his continues to the end of December or near it, when he begins again to move forward and so on: To places in north latitude, the sun rises to the northward of the east and sets to the northward of the west, from the vernal to the autumnal equinox, and rises to the southward of the east and sets to the southward of the west, from the time of the autumnal equinox to that of the vernal.

As the moon finishes her monthly course, or grand revolution, twelve times a year, or in a space which is about 10 days and 21 hours less than the solar year, it may, perhaps, be imagined that she is twelve times nearer than the sun to the earth, allowing the velocity of both to be the same. But,

probably, the motion of the moon is far swifter than that of the sun: by our ignorance, however, of the exact measure of both the solar and lunar walks every 24 hours, and what the squares of their distances from one another, as well as from the earth, may really be, it will be merely impossible to determine this question. As to the *phases* of the moon, though she does not pass from one sign of the zodiac to another like the sun, yet we can come to conceive the line of her motion in the following way. Suppose the path of the sun to be along the concave side of some great circle, and the earth to be the centre of that circle; while the moon's walk is along the concave side of a less circle, situated between the external circle and the centre, cutting the *radii* of the great ring at right angles. Now, her appearance, when entering the *radii* of *Aries*, to the inhabitants near the arctic circle, is what we call the last stage of the second or last quarter. Then, in the space of seven days, she totally passes the regions of *Aries*, *Pisces* and *Aquarius*; from the seventh to the fourteenth, she passes the regions of *Capricornus*, *Sagittarius* and *Scorpion*, during which time she is invisible to the

above-mentioned inhabitants; but after the 14th to the 21st she appears increasing and coming horned from the south to the north. Passing then *Libra*, *Virgo* and *Leo*, she is said to be full; upon her entrance into *Cancer* she begins to decrease, and become gibbous, and so on till she leaves that sign behind with *Gemini* and *Taurus* to the 28th. Entering *Aries* again she appears in her second or last quarter, and disappears as before. The moon passes the sun in the west, on her northern expedition, at his setting time, and also repasses him in the east, at his rising time, proceeding on her southern tour.

Both are said to be in conjunction or opposition, upon the moon's nodes coming opposite to the centre of the sun at new or full moons; then, the sun, moon and earth are all in a right line. Hence, solar and lunar eclipses happen; when the moon is new, her shadow may perhaps fall at times on some part of the earth, and so intercept the light of the sun there; if the moon is full, the



immovable earth's shadow may fall on so many of her digits and destroy her reflection. †

---

† *If we grant that the light of the moon, says Fontenelle, is no more than the reflection of the solar light, the lunar substance, therefor, must be some solid thing like polished marble. The discovery of some astronomers almost confirms the opinion; for they perceived a particular figure in her, which had the air of an old woman's face jutting out of rocks, and this may be owing to some changes happening there. Pieces of rocky mountains have, perhaps, mouldered away, leaving three prominent points behind, which can only serve to make up the forehead, nose and chin of an old woman.*

*Some suppose, that the spots observed on the surfaces of the moon, Jupiter, &c. are seas, forests, and cavities, which as such are incapable to reflect solar light in the way the dry and naked land there does. May it not be more rationally imagined, that the planets as great electric-bodies, and amazingly full of an attractive power, do rather draw from time to time terrene and aqueous particles from our terrestrial atmosphere, by which collected dust and fog certain parts*

*of*

If we espouse the opinion, that the moon's light is unborrowed and independent of the sun, which by the by I think we should; under that view the phenomenon of lunar eclipses must be otherwise accounted for than it is at present, which is believed to happen in consequence of the moon falling into the earth's shadow, when the sun and moon are in opposition, and the earth diametrically intervening. It is far more reasonable to think, that the moon, when she appears to us like tarnished copper, is then directly in the *focus* of the earth, and out of the sun's influence in respect

---

*of their bodies are incrustated and obscured, that is to say, where strong currents of air and electric fire are not alternately passing to and from them? In a similar way, perhaps, as we see snow sometimes violently drifted on the earth, covering one spot to a great depth and leaving another exposed.*

*The spots or nuclei observable on the disk of the sun, by parity of reason, may be accounted for in the same manner.*

to attraction; at which moment, the whole electric fluid, on the lunar side of the earth, is attracted and converged by her; in the same manner as a burning-glass collects solar rays into its *focus*. Then, the stream of electric fluid, blowing like a bellows, extinguishes her vivid and pale lustre; just in the same way as a bellows extinguishes the flame of a coal, while it blows on; the coal appears, then, like red iron only and without flame, but immediately, on the torrent of air being over, it resumes its former appearance.

---

## SECTION VIII.

### *Objections shown against the planetism of the earth.*

**T**HE earth, from its essence or nature, is a place or particular portion of absolute space, the sun can with the same propriety be called part of absolute space likewise. What invisible power, or visible and natural cause, holds the sun, the one place, seemingly immovable and at rest relatively

as to its systematic other parts, but might keep the earth, the other place, in a fixed state also?

The parts of space cannot be seen or distinguished from one another by the senses; in their stead, therefor, we are obliged to use sensible measures of them, for, from the positions and distances of things from any body, considered as immovable, we can only, it is clear, describe all places. The four cardinal points in absolute space are only necessarily imagined mathematical-points, for our government in the knowledge of the mutual situations of the earth and celestial bodies to one another.

In the system which would draw us to conclude, that the earth is revolving daily on its axis, it is likewise urged, that it performs an annual course round the sun. Now, during this grand annual-circuit of the earth, † it must unavoidably shift, relatively speaking, from the west to the east side of the sun, and from the east round to the west side again, that

---

† *The great orb of Copernicus.*



is to say, alternately to and from opposite sides, so as to describe one complete circle round him as its centre, once in the year.

To comprehend this by the easiest demonstration; a person, laying down his watch upon a table, may look to the dial plate, and suppose the figure XII to represent the east, the figure VI the west cardinal-point, and the centre-pinion to be descriptive of the immovable sun, let the minute-index be then crossed by a bit of chalk in two places. Consequently the nearest score to XII will be east of the other, when the index is at that figure, and as well the index itself will be then wholly east of the pinion; but when it veers about to figure VI, the above-mentioned east score comes to be west of the other, which last now in site is the east score, and the index too, in its turn, is totally west of the pinion. In like manner by the Copernican scheme, not only the earth's situation, but also its different sides must be, to our confusion, perpetually shifting and changing place from west to east and *vice versa*, relatively speaking as to the sun.

Thus, we might be equally surprised at the end of every six months, if during that space, we were subjected to such transitions in absolute space, as one would be, who was confined for 12 days within the cabin of a ship, moored in smooth water, and with the stern due west; accordingly, he would at first see the sun setting, every evening, someway opposite to the cabin windows, but after the lapse of six days, while he was perhaps asleep, if the ship was put about, and the stern brought to bear exactly east, and moored so again, upon the seventh morning the sun would appear to him rising in the west. Unless apprised of the ship's recent motion, his reason and eye sight would be apt to come directly to an open rupture.

Supposing, that the moon and her primary move relatively through a semicircular course, which has the sun in a western situation to them for six months every year, how happens it, that we behold him and the moon passing one another, in the mornings at certain periods during those six months, in the east quarter of the heavens?

It is certain, if the sun does not move round the earth, that it must be moving round the sun; be it so for the sake of argument, consequently, the earth instead of the sun is to be in that case supposed as passing from sign to sign in the zodiac; therefor, we must reverse our usual way of speaking, and say, that the earth, when converted to a planet, was about entering the regions of *Aries* at the time of the vernal equinox, as seen from the northern hemisphere; now, the earth in course must have been in *Libra* at the next and every following autumnal-equinox. There is one particular and well vouched phenomenon to confute this, to wit, the sun, moon and all the planets being seen in conjunction in the sign *Libra* upon the 14th of September, which was about the time of the autumnal equinox, A. D. 1186, or in the 5895th year of the Julian period.

Provided the earth is moving yearly round the sun, its route should be either in a circular and horizontal direction, or along his zenith and nadir. Therefor, if the path of the earth be horizontal, we could never see the sun vertical but opposite

to us, in the way people in a small boat should see a ship at anchor, round which they rowed. Or, if the earth's walk is up and down round the solar globe, we ought in that case to be looking down but never up at him during every half year; in the manner, comparatively speaking, persons from the globe of a steeple-spire, let their positions there be erect or inverted, should view the light of a bonfire placed near the foundation of the steeple.

It appears, however, we shall be obliged by the Copernican philosophy to call that part of celestial space, where the sun is seen in the morning, *east*, whether the earth is really upon his east or west side; and when he comes about to a meridian line, we must in like manner say he is *vertical* to us, though in fact we may be then vertical to him. Hence, distinction in our own particular situations would be continually lost; for, adopt the notion of the planetism of the terraqueous globe, and every moment thereafter, our right and left, antierior and posterior, vertical and



footling inclinations and positions, as to the sun, will be misunderstood and mistaken.

Astronomers of the present age have determined, from their observations upon the *transit* of *Venus* in the year 1761, that the mean distance between the earth and the sun is 95,173,000 miles, and his diameter they calculate at 890,000 miles. Consequently, as the path of the earth must run through equidistant imagined-points beyond the sun; a diametrical line, therefor, drawn from any part of the earth's surface, straight through the body of the sun, to an opposite point in the earth's walk, will amount to 191,236,000 miles. Multiply this diameter by three, in order to find the exact circumference of the annual course of the earth, † and 573,708,000 miles will be the mea-

---

† 1. *The idea of a planet's moving in ellipses, since the Divine Hand gave the first projectile-impulse to it, seems to have been borrowed by Galileo from the appearance a small stone or any other body makes, when*

surement in circumference of that prodigious orb. Divide the above number of miles by 365, in order to determine each day's march, and the *quota* sought will be  $1,571,802\frac{2}{3}$  miles, being a jerk of 1092 miles every minute. In the next and last place, divide this daily journey of the earth by

---

*when violently flung from a sling through the air, which, while flying off, describes petty circumvolutions.*

2. It was imagined by Sir Isaac Newton once, that a planet, perhaps, shaped its course round its centre in lines drawn from angle to angle; this opinion, however, on revision was laid aside, finding the centripetal and centrifugal forces could fight their battles in another kind of mathematical figures, namely, in ellipses. The worth of both the foregoing schemes has been elsewhere brought to view, so far as they tend to consider the earth a planet; a notion never expressly approved nor disapproved of by Sir Isaac.

3. Some astronomers consider the attitude, in which the earth performs its movements, to resemble the appearance that a spindle, put through a ball, would make  
when

23,910, viz. its supposed circumference in miles, and above 66 will be the product wanted. Hence, in the space of every 24 hours, we ought to have above 66 solar illuminations and as many obscurations. If we suppose that the earth zig-zags continually, deviating from one uniform and cur-

---

*when rolled over a bowling green; thus, while the one end of the spindle, by mean of the ball, would be hobbled along the ground, the other end should point to some quarter of the heavens.*

4. Other theorists observe, that the revolution of a ball along a billiard table may not unfitly be compared to that of the terraqueous globe; the ball, after an impulse, revolves seemingly afterwards on its axis, by the joint actions of its own gravity and the resistance of the table.

5. Some, again, compare the motion of the earth to that of a school-boy's top, which, after receiving smart scourges, moves round in a circle, and all the while keeps spinning on one extremity of its axis. This whirlingig notion is just as childish as the spindle-scheme is futile and laughable. An unanswerable objection to this

vilinear course round its centre, consequently, its diurnal rotations will multiply in proportion to the space it has to traverse; therefor, as two sides of a triangle, or two equal sections of a cone, are double to one side or section, in the same way, the combined vicissitudes of light and darkness should

---

*this and the two preceeding hypotheses is, though we should allow the motion of the earth to have some likeness to the play of a spindle, bowl, or top, yet where has it a green, table or floor to run upon?*

6. *Another species of motion, which was assigned by the ancients to celestial bodies, particularly the sun, is wheel-machine carriage. It must have been some brisk motion of this kind that Copernicus had in his eye to the earth, when he made a planet of it. If we had the smallest certainty that such fiery chariot and horses, as parted Elija and Elisha, were carrying us and the earth round the sun, for my part, I should see and get myself still disengaged from the idea of the earth's stability, and come in to such easy mode of travelling.*

7. *Another method of journeying some of the ancients*



swell to above 132 every 24 hours, and even to more in case it moves in regular *ellipses*.

Some deliberate kind of motion, as that of a ball rolling on a billiard table, is what should be ascribed, if it had any, to the earth; and because,

---

cients ascribed to the earth, which must have occurred earlier than charioteering, was its being born upon the backs of a herd of elephants. This opinion is not yet extinct among some tribes and nations, where the human mind is, alas, still disgracefully degraded below its natural state! If the earth is thus cavalcading, we may admit that its beasts-of-burden must be grievously overloaded; now, experience teaches, when animals are miserably oppressed, they walk at a hard pace the one while, and stand still at another time; consequently, it might be inferred, the earth is neither at rest nor in motion.

8. Lastly, another scheme entered the lists, and perhaps the most wise of the whole, viz. that the earth is at rest, being supported some how like a scaffold on pillars. No doubt it is equally difficult to determine

an impressed force remains no longer in a body, when the exerted action or pressure on it is discontinued, as bodies maintain whatever new state they acquire by the force of inactivity only, agreeably to the Newtonian principles. Therefore, we cannot admit, that one rotation of the earth exceeds a space equal to its circumference, no more than that of the ball rolling on a table, by the mutual actions of its own specific gravity and the repulsion of the table without any borrowed force, should exceed the measure of its circumference during every revolution.

These demonstrations simply may be enough to show, that the Copernican scheme, if its true co-

---

*on what foundation those pillars are standing, as to tell what kind of road the elephants travel upon. It is, however, to be observed in favour of the present scheme, that there are other mechanical ways, beside propping, to make a body keep its place, as by some mechanical mean of suspension or other, magnetic libration, or both.*

lours are taken notice of, appears too far pushed and rather wild.

A striking inference has been made from the supposition of the earth being always in rapid motion, and that is, how birds, which might chance to be in detached aerial situations from this globe, would be apt to be frequently deserted by it, and left in some unknown region of absolute space, as it could not possibly be expected theirs would be sufficient to keep pace with its velocity. This idea suggests to us, provided a bird flew westward over a course, suppose, of 100 miles in one day without approaching, nor at all lighting upon the earth, to participate relatively in its motion, amounting in this given time to  $1,571,802\frac{2}{3}$  miles eastward, how perilously it should appear, that the same bird could ever afterwards overtake the earth, unless the universe is considered one mighty whirlpool, and say it should be so, it is a thousand chances to one, the bird would perch on some other planet, but never upon its native one again.

If a person is resolved to consider the earth in no

other but a wandering state, and tumbling from west to east daily, in that case, he must allow, that the *impetus* of the whole terraqueous mass should at all times tend eastward; but it is far otherwise, and the fact is well established, that the constant motion of the ocean is rather from east to west; being influenced by the sun and moon, as they soar along, a general tide is necessarily raised westward therein.

Within the tropics, there is likewise a constant east-wind, throughout the year, blowing on the Pacific and Atlantic oceans. This is occasioned by the action of the sun, who, in his career from east to west, heats and expands the air immediately beneath; by which mean, a stream of the exterior condensed-air pours always into his tract; hence, a perpetual east wind is occasioned within those limits.

The wayfaring fowls of the air, while flying towards the east, should also be much retarded by the extraordinary torrent, which the earth's rotation raises in the atmosphere, but greatly for-



warded in flying the contrary way. To weaken any idea, that may arise respecting a swifter course of air setting perpetually from the east more than from any other quarter, excepting what the heat of the sun occasions, it is observable and well known, the aerial fluid is sometimes totally at rest over large regions of the globe without the torrid zone, and when agitated there, its direction may be from all the different points of the horizon. Between the tropics, its motion is general and equal for the reason already assigned: in some parts, its impetuous motions begin and end at stated times of the year, nay, at one certain hour of a particular day; every morning and evening, land and sea breezes are known to succeed one another in other parts of the globe; and, there are places where the winds are variable in their direction, velocity and duration.

## SECTION IX.

*The same subject continued.*

**F**ROM the one end of *scripture* to the other, we have neither one direct nor indirect hint, that this terraqueous globe of ours is no more than a wandering body, or planet.

Where wast thou, when I laid the foundations of the earth? Who was it that laid the measures thereof, and stretched the line upon it? Whereupon are the foundations thereof fastned, or who laid its corner stone? God, or his angel, thus enquired of *Job*.

*David*, the distinguished sage, poet, hero, king, prophet and priest of Israel, rather informs us in the plainest language, that the foundation of the earth was laid at first firm and fast; which remains so steady and stable, that it can never be accidentally moved. The Lord founded the earth, says he, upon the seas, and established it on the floods; He spake and it was done, He commanded

and it stood fast; his strength setteth fast the mountains; the world with its fulness were fixed and with-held by Him from moving.

In like manner, *Solomon*, the wisest and most intelligent of men, asserts, that the earth abides and rests still always.

It is indeed true, many writers, and among whom are some who style themselves astro-theologists, look upon the testimony of sacred record often as equivocal and of little force, except in the direction they are pleased to level it. They do not hesitate much to say, that it was never designed by the scripture-channel to brighten the light of nature otherwise, than merely to impress the human mind with moral and religious precepts, as if those objects and the exercises of our greatest and best endowment *reason* were incompatible. † They still further add, that it is not ne-

---

† Here, a common aphorism seems to be revered, viz. that ignorance is the mother of devotion.

cessary to give implicit attention to numberless sacred-texts, nor limit them to a literal sense and ordinary acceptance; particularly, so far as they respect the creation, establishment and order of objects in our system; since, forsooth, it falls out the province of modern philosophy to clear up those researches! For my part, I do not understand, nor as little can agree to such heterodox, others perhaps may; viewing one part of sacred history in a wrested or reversed meaning, excepting what is plainly delivered in a figurative and allegorical form, leaves an open for the easiest transition of other more important passages, perhaps, to fiction and perfect romance. Distorting and disfiguring sacred-truths, in order to suit the prejudice and passions of men, made a capital corner-stone in the fabricated system of the church of Rome; this, however, is no precedent, why we should suspect *Moses*, *Joshua*, *David*, *Solomon*, the later prophets and inspired writers to have counterfeited their sentiments concerning the order of the universe, or things of that nature, from pure complaisance, or being any how obliged to dissemble, with a view to gratify the prepossession-



ons of the populace, as many are inclined to think. These eminent men being kings, law-givers and generals themselves, or always privileged with access to the courts of sovereign princes, besides the reverence and awful dignity which the power of divination and working of miracles procured to them; therefore, much worldly as well as spiritual authority and control must have fallen to their share. They never were daunted to speak out the truth, as their warrant was abundantly strong, before the most mighty potentates on earth; much less, are we to apprehend, they would be overawed or hummed by the *vox populi*, in matters that did not molest the temporal interest or carnal pursuits of any.

Can it be supposed that persons, who had often in charge to command, suspend, revert and otherwise interfere with the course and laws of nature, should not avail themselves in the attainment of a competent insight into the natural causes of things? The feeble and circumscribed philosophy of the ancient schools of Babylon, Alexandria,

Athens and Rome, with all the modern refined learning of the western countries of Europe †, for the space of 4020 years, to wit, since celestial observations commenced first at Babylon, cannot be equalled to the instruction of God for one minute. Lo, says He to Solomon, before the latter hardly finished his request, thou hast already re-

---

† The study of astronomy has been, hitherto, pursued only by the inhabitants of a very narrow stripe of the globe. Naming, subdividing and registrating the stars were begun first in Chaldea, a country lying eastward of the Persian gulph. Along the champaign coasts of the Nile, afterwards, for geometrical intentions and purposes, the Egyptians cultivated an acquaintance with the stars; in the way, navigation has obliged mankind of late to observe them more strictly. Though this science received much improvement and refinement in Greece and Italy of old, yet during the middle ages, it came to be in common with other branches of literature almost extinct; and it is only within these 300 years the glimmering of it crept from Italy by Tuscany to Denmark and the western coast and isles of Europe. It was within this period,

ceived a measure of understanding and wisdom above all that were before or shall be after thee!

Yet, there are selfish men, who, instead of entertaining exalted ideas of those oracles of heaven, incline rather to have them degraded. If their inspired qualification, say they, was out of question, what were those men but illiterate boobies, immediately out of the hands of the universal

*period, astronomy assisted navigation so far as enabled a Genoese to discover the new continent, and a Portuguese to double the Cape of Good Hope; Europeans before then relished rather the barbarous customs of feasts, tumults, tournaments, duels, scholastic divinity and witchcraft. By some fatality, astronomy is not cultured even still in the eastern hemisphere, but within a contracted field; which, perhaps, does not much exceed an area of 20 by 30 degrees, viz. from Sardinia to Peterburgh, and from the source of the Danube to the Atlantic shore. In the western hemisphere, it is, so to speak, only an exotic plant, excepting in the instance of the phenix-twig that flourished, flowered and seeded at the side of the Delaware.*

in comparison to the present *learned* generation; nay, they might, perhaps, be considered little better than speaking parrots and trumpeting androits? Says a certain uppish writer, *Adam's* knowledge did not, probably, exceed that of a gardener, who is possessed of so much understanding as is requisite to dress a common kitchen-garden †. This was his opinion of *the mind*, that came finished immediately out of the hands of the universal Bestower of understanding, knowledge and every intellectual power!

But to return from a necessary digression; however averse sceptics are to countenance mira-

---

† Some had gone to the other extreme; a Carthusian friar, encomiating Aristotle, whose philosophy made more noise in the world than even that of the Archimedes of England, asserted his knowledge was extensive as Adam's. Some rabbies contented themselves with equalling Adam's understanding again, to that of Moses and Solomon, while others went so far as to affirm it excelled that of the angels themselves.



cles, and prone to reduce every thing to the level of human understanding and demonstration; yet, it must be confessed, that the creation of the terraqueous globe, in the way it stands, was an amazingly omnipotent and stupendous action, which far surpasses the comprehension of man. It would, in my opinion, be still a greater exertion of power to conduct and regulate the incidences and *phenomena* of one rotation of it, was such a thing to happen, especially if rolling forward with the velocity of 1092 miles every minute.

To illustrate this, let us revolve the following *hypothesis* in our minds. Suppose a person, invested with temporary omnipotence, stood on the summit of some high mountain, and had then caused an atom, invisible to the eye as well as indivisible by the hand, to assume the figure of an orange, with the weight and magnitude of a cathedral; three fourth-parts of this globular body being covered over with one sheet of water of various depths, and the dry part strewed with ten thousand loose masses of matter, animated and inanimated, light and heavy, and the whole maintain-

ing their stations upon the surface, from an universal attraction between them and the globe, though which of them were the attracting or attracted bodies could not be fixed in an opinion. Now, if this potentate, after giving a curvilinear impulse to the new formed body, had commanded it to move in a circle through infinite space, and after running a course equal to 573,708,000 miles round the sun, and to return again in  $365\frac{1}{4}$  days to the exact point it started from. Here, may it not be asked, whether the original formation of that erratic body, or the future government of it, should appear most extraordinary? Especially, when we take in, that not one of the moveable bodies fell off, nor a single drop of the water was spilled, though constantly attracted and drawn away, externally, by the sun and other celestial bodies, and impelled internally by its centrifugal force; not altering a jot out of the prescribed line, and withal flying with rapidity superiour to lightning. Such circumvolution, through the air, would be a hundred-fold greater display of supernatural agency than the original creation of the object; besides, the repetition of such excursions,

for 5790 years, would be, to all human conception, a continued series of complicated miracles; doing a thing at once is, only, the exertion of power for once.

It throws forth one formidable argument in favour of the opinion that asserts the earth's stability, the apparent immobility of the fixed stars with regard to one another; whereas, if the earth was moving swiftly through boundless spaces, in that event, we should naturally conclude, and even be certain, considerable variations in the apparent places of the fixed stars would be sensibly taken notice of by us, at different times of the year.

There is one specious and very delusive argument, used by the followers of *Copernicus*, towards promoting the credit of the earth's mobility. Men, say they, on the deck of a ship under sail, think that the shore, which they are passing, moves from them in a contrary and regressive direction. This is entirely owing to fallacy in our vision, or an optic deception founded upon an

incapacity in our organs of sight. In like manner, our eyes deceive us in the instance of men standing upon a very level plain, which does not seem to rise sensibly but at a great distance from them. The plain, therefor, has an apparent curvature in it at that distance, but the form of which is not easy to determine; so that one standing upon any level surface of immense extent will imagine, that he is situated as if in the centre of a basin; this would likewise, in a great measure, be the case with any person standing upon a raft in an open sea.

Say, that we, who inhabit the north-west end of the terraqueous globe, when going east-ward, should imagine the sun, then on our right hand, to be moving the contrary way; yet, how comes it to pass, that when we behold him nearly opposite to us at east in the morning, or when we turn about and view him in the west quarter of the heavens towards night, that our senses consider him then in motion as well as when he is in a lateral direction? The sun's motion at any rate, being without the limits of our vision, is totally



determined by the mind ; because, visible objects, moving with any velocity, appear to be at rest, provided the space described in the interval of one second be imperceptible at the distance of the eye. Hence it is, that a near object moving very slowly, as the hour-index of a clock, or any remote one very swiftly as a planet, seems to be at rest.

The eye advancing from one place to another, and being sensible of its motion, distant objects will appear to it as moving the same way and with equal velocity. Thus, to a person running eastward, the moon on his right hand seemingly moves the same way and with equal speed, for by reason of the distance, her image continues fixed upon the same spot of the *retina*; thence, we imagine that the object moves with the eye.

If both the eye and object move the same way, only the eye much swifter than the object, the last will appear to go backwards.

If two or more objects move with the same velocity and a third at rest, the moveable ones

will appear fixed and the quiescent in motion the contrary way. Thus, while clouds are moving very swiftly, their parts seem to preserve their situations, and the moon to move the contrary way.

When the eye is moved with great quickness, lateral objects at rest appear moving the contrary way. So to one sitting in a coach and riding briskly through a wood the trees appear to retire regressively, in the same way as the passed shore seems to recede from people a ship-board.

All these observations tend to prove, that in certain circumstances we are liable to optical deception; when therefor, one of our senses is incapable to determine, nay, rather apt to deceive us as to this or that phenomenon, we should instantly then appeal to the mind.

The relative *phenomena*, again, of bodies in actual motion, though ideally applicable to bodies not so, provided they moved, do not, however, evince that all bodies at rest must be deemed in motion.

## SECTION X.

*Electric phenomena, especially attraction and repulsion, explained on mechanical principles.*

OF all the bodies we know, there is none in so constant and violent an electrical state as the higher regions of our atmosphere. If one sends up, the height of 100 or 200 yards, a silk handkerchief extended on two cross sticks, in the manner a schoolboy's kite is constructed; to which a string is fixed, composed of two plies of common twine and one copper thread, such as is used for trimmings, the string being again tied below to a key held by a ribbon in the hand, and at all times this little *apparatus* will conduct electric fire to the key and charge it, whether the air be clear and without clouds, or very thick and hazy. Indeed, we may often judge of the higher regions being in the most powerfully electrified state, from the impetuosity with which the clouds are frequently agitated, from the meteors formed above the nebulous regions, and particularly from the *aurora borealis*, which has been, invariably, observed to

have much the same colour and appearance as the matter of which the tails of comets are formed.

*Dr. Hamilton* † supposes, with a good deal of propriety, that the tails of comets are streams of electric matter; indeed, their resemblance to streamers is so strikingly great, that it is not possible to ascribe the one to electricity, and the other to any other different cause.

The electric power, as experience proves, so far from diminishing, grows much stronger the higher we are able to ascend into the celestial regions. As we can, therefor, set no bounds to its increase, we may reasonably conclude, that the moon receives electricity from the earth, perhaps, as the cork-ball in the following experiment receives it from the knob of the vial; and her being continually drawn off by the sun may occasion her circulation in a similar, though much more regular manner.

If a light and hollow ball of cork, covered over with brass or gold leaf, be suspended by a

---

† *Of Dublin, I think.*



pretty long silk-thread, so as just to touch the knob of an electrified vial, placed upon the experimenter's table, it will be instantly drawn off to some distance, and after few vibrations will remain at rest. If a lighted candle is then placed at some distance behind it, so that the flame of the candle may be nearly as high as the knob of the vial, the cork will be instantly agitated, and, after some irregular motions, describe curves round the knob of the vial, seemingly of the elliptic sort, and this it will continue to do, sometimes moving in one direction and sometimes in another, till the force of the electricity in the vial is almost exhausted. It must be owned, however, that the circulation here is far from being regular; but those irregularities can only be attributed to the want of skill in the operator, to adjust his forces to one another in the properest manner. When men, by mean of a few sparks from an electric conductor, can cause a cork to perform some hundred revolutions in an irregular manner round the knob of a vial, what cannot the Deity do, through the *medium* of any second cause he pleases? Who has the whole power of light and electricity

at command, who knows their nature perfectly, and whose mechanical skill has no limits, and moreover, who can impress any nature essentially necessary upon the materials employed. That the combined powers of electricity are capable of generating motion in a body round a centre, is here proved by experiment, which in all cases is worth hundred speculations.

The harmony subsisting among the heavenly objects, it is true, is one of the best arguments adduced in support of the Copernican scheme. But, where can disorder, deficiency or redundancy more than there be discovered, throughout the infinity and wonderful arrangement of the whole frame of nature?

*Light* is mentioned by various authors, as an operating and distinct matter in nature; if it is so, consequently, it should be considered a fifth element; though I may be wrong, it appears to me to be only a quality, or rather an action of the sun, such as the light of every terrestrial fire exhibits in miniature to us, propagated in succession outwards by the prodigious elasticity

and refraction of the air, † and again reflected by any opaque *medium* or body that may intervene. Therefor, the pure light of the sun, and likewise that produced from the gross flame of terrestrial fire may be considered only as illuminated streams or beams of electric fluid, carried off suddenly to the circumference, as it were, upon the wings of the air. By taking this view of light, we can easily account for the phenomenon, which the lighted candle produced in the experiment of the cork-ball.

*Otto Guericke* discovered, about 100 years ago, that a feather, if repelled by any excited electric, keeps always the same face towards the body that repels it, in the same manner as the moon does to the earth.

About the year 1729, Mr. *Stephen Gray* made some capital experiments upon the projectile and pendulous motions of small bodies by electricity,

---

† *By what way is the light parted, which is scattered by the east-wind on the earth? The Parent of the universe, or his angel, thus asked Job.*

in imitation of the planetary motions; which appeared exceedingly curious and remarkable. Small electrified bodies, held by threads in his hand, he found, would move about large ones, either in circles or *ellipses*, whether concentric or eccentric to the centre of the large body, round which they moved, producing many revolutions. These little planets, if they can be so named, moved faster in the apogee than in the perigee parts of their orbits, which is directly contrary to the motions of the planets round the sun. This circumstance might, however, arise from the nearness of the small bodies to their electrifying centre; if too near, the immense degree of attraction then taking place might so much retard the motions of the surrounding bodies, that they would become even stationary, as happened in the instance of the cork-ball; whereas if their perigee was removed to the place of their apogee, and the latter to extend beyond its former limits, in that case *Mr. Gray* would, probably, find his experiments to succeed more harmoniously and according to the celestial *phenomena*; due proportion is as indispensable in the adjustment of



distance as other circumstances. Hence, from analogy, the moon may be considered as retained in her orbit merely by the power of electricity; for we observe, that she keeps always the same side towards the earth, just as in the above mentioned experiment, a small electrified-body did towards the body that electrified it.

The exceedingly great velocity and strength of the electric fluid are not owing to any repulsive quality among its own particles, as has been imagined in former times, but to the mutual action of the air and electric fluid upon themselves and one another. This fluid, being capable of having its motion resisted by the air, must inevitably fly, whenever that happens, to the place where it meets with least opposition. From this simple principle, *viz.* that fluids impelled by any force, will always tend towards the place where the least resistance is, the bulk if not the whole of the *phenomena* of electricity may be explained.

The electric fluid only shows itself passive, when passing from one body into another, which it

seems very inclineable to do spontaneously; and after the proper examination of all its appearances and effects, it will be found, that the only way we can manage it at all is, by allowing it to direct its own motions. In all instances, where we attempt to assume the government, it shows itself the most untractable and stubborn *being* in nature.

It is enough to prove the non-repulsiveness of the fiery fluid as to itself, that whenever it has to pass through an exhausted tube from the prime conductor, it will not diverge, but advance in one continued arch or column of lambent flame, the resistance of the atmosphere being then removed, the fluid and light would have room to spread more diffusively, if endowed with power repulsive of itself. A column of air too, blown swiftly through the orifice of a small pipe, will go forward a considerable way, if it is counter-balanced by air of the same kind on every side. But if this column of air was to enter a *vacuum*, what is called its elasticity would occasion its dissipation in one moment, and an equal diffusion of it through the whole exhausted receiver, which is

by no means the case as to the electric fluid. It is presumable, that there may still remain, in the *vacuum* of an air-pump, a species of fluid of nearly the same density with the electric, which though never repulsive of itself, yet is resisted by any atmosphere; hence, all appearances of electric light are less bright *in vacuo* than in the open air, because the more resistance this matter meets with, the brighter is the flash. Thus, as long as the stream of electric fluid is moved through any *medium* of an equal density with itself, the equable pressure of the fluid all round will keep the luminous stream from diverging, but if the pressure is taken away from any part of the receiver, the pressure of the rest will immediately force the stream to this place. That it is by some pressure of this kind, and not by any obscure attractive power, this is occasioned will be rendered very probable from the following example. Suppose a pot with water is boiling violently over a fire, and in such a situation that there is not the smallest commotion in the surrounding air, the equal pressure of the atmosphere will then force the steam straight upwards in the form of a pillar;

but if any body is brought near the edge of the pot, by mean of which the atmospherical preffure is taken off on one fide, the steam will be directly forced upon that body, or feemingly attracted by it.

From what fource the electric fluid originally derives the aftonifhing agility and prodigious firength, difplayed in its movement, is an object worthy of attention. If it is granted, that it is the fame with the folar light, the ultimate caufe of its force muft be the power by which the light of the fun is emitted. As this power extends through regions of fpace, which to our conceptions are truly infinite, fo muft the power itfelf be; and it is clear, that, by its equable action through the whole fpace, in which the fun's light is propagated, the furrounding preffure of it upon all bodies muft be equal, and confequently, it can neither move them one way or another. But, if by the intervention of fome other power, the preffure is leffened upon any particular part, a current of electric matter will fet towards that part, with a force exactly proportioned to the diminution of the preffure.



Thus, in the ordinary experiments of the air-pump, when the air is exhausted from a glass vessel, the pressure of the superincumbent atmosphere will be directed towards every part of it, so that, if its shape is flat and square and not very strong, it will certainly be broke to pieces. Here, however, after the air is exhausted, the vessel is discovered to be full of another subtile fluid of the same nature with the electric. If this also could be extracted, the pressure on the vessel's sides would necessarily be much greater, because, not only the atmosphere, but the whole encompassing ether and electric fluid, would urge towards this place, and it is not probable the incumbent force could be resisted by any terrestrial power whatever. The force and weight of the fiery matter, therefor, in our experiments depend on two causes, *viz.* the pressure of the atmosphere upon the fiery matter, and that of one part of this matter upon another; a vibratory motion, excited either ways, is what constitutes the very essence of what is called electricity.

The celerity with which the fiery fluid moves,

may be explained from its parts lying in contact with each other, throughout the wide immensity of space. Hence, the motions, and seeming accumulations of it must proceed only from its more brisk action in some places more than others. From the metamorphoses of positive into negative and negative into positive electricity, it is demonstrated in the most decisive manner, that the one does not consist in an accumulation, nor the other kind in a deficiency of the electric fluid, but that both of them arise entirely from the different directions, into which the fluid is thrown in different circumstances. It hath been shown, in bodies electrified positively, there is a flux of fiery fluid from their surface all around, that is to say, the fluid contained in their pores pushes out on every side, and communicates similar motion to what is contained in the adjacent atmosphere. This must of necessity very soon exhaust the body of its electric matter almost altogether, if it was not instantaneously supplied with more after every emission, but this supply is immediately procured from the surrounding atmosphere.

Positive electricity consists in a vibratory motion of the air and electric fluid, and the force of this vibration is always directed outwards from the electrified body. Whereas, in bodies negatively electrified, the course of the fluid, contained in the neighbouring atmosphere, is inwards and towards the body so electrified; but it is certain, that this motion cannot be continued, unless there is also a motion of the fluid outwards from the same body. In this case also there is vibration, whose force has an inward direction, and as the source of it lies not in the body but in the atmosphere, it manifests itself less vigourously; and the reason, why these motions remain so long, is the extreme mobility of the fluid, having not the least friction among its parts. A motion once induced into it must, therefor, continue for ever, until it is counteracted by some other motion of the same fluid. Hence, when a vibratory motion is once introduced among the particles of the electric fluid, contained in any substance, that motion will be aye kept up by the surrounding fluid, let the body be removed to what place we please.

The *phenomena* of attraction and repulsion can now be understood with ease. Thus, let us suppose a body positively electrified to be suspended, by a small thread, at some distance from any other, the vibration above-mentioned, in which positive electricity consists, being kept up by the equable pressure on all sides, the body is neither moved to one side or another; but when a negatively electrified body is brought near, the force of the vibration being directed outwards in the one and inwards in the other, the pressure of the fluid in the intermediate space between the two is greatly lessened, and of consequence, the pressure on the other sides drives them together, when they are said to attract each other.

If another body, also electrified positively, is brought near the first, the force of their vibrations are directly opposed to one another, and therefore, these bodies recede from each other, when they are said to repel one another. The case is the same with two bodies negatively electrified, for there, electricity, so far as it extends round the bodies, consists in the vibratory motion of the



fiery fluid, and the vibrations being directed towards both bodies, as towards two different centres, this must necessarily cause them to recede from each other, because if they remained in contact, their motions would interfere with and destroy one another. There are zones of positive and negative electricity in earthy † and watery bodies as well as in the air, zones of both kinds will gradually succeed each other, till no traces are to be found. In those zones it must be remembered, that there is one centre peculiar to each, and to or from this centre, vibration proceeds either inward or outward.

---

† *In a small island, few leagues north of the well known and much celebrated Staffa, is a harbour, whose craggy-shore is generally in such magnetic state, that it strongly attracts the compass-needle aboard vessels, the moment they anchor there; superceding entirely the former directive or inclinatory powers thereof, until the vessels depart.*

*Through His Britannic Majesty's munificence, not many*

## SECTION XI.

*An attempt to show mechanical causes for the suspension and equilibration of the earth, in the centre of the expanded system of nature.*

**T**HE relative position of the terraqueous globe in regard to the heavenly objects, though a theme, perhaps, beyond the reach of human saga-

---

many years ago, an experiment was made by Mr. Maskeline, the Royal astronomer, on the attraction of the mountain Scheballien in Scotland. The observations were made, by taking the meridian zenith-distances of different fixed stars near the zenith, by mean of a zenith-sector of 10 feet radius; first on the south, and again on the north side of the hill, the length of which was in an east and west direction. Hence, the apparent zenith-distances of the stars would be affected contrarywise, by the deflection of the plumb-line towards the hill in either stations. The result was that the sum of the two contrary attractions of Scheballien was equal to 11,6.

This

city, yet seldom missed to take up the thoughts of philosophers in all ages.

The earth in the beginning was blended with water, which water soon was divided, and a firmament interposed between its two subdivisions in the expanse of the heavens, that is to say, between or amid those waters that receded above and those which gravitated with our globe.

Whether this was done by the reciprocal actions of the qualities of levity and gravity, then first taking place, or by any other mean, we have it not in our power to know, nor will our speculations on this subject, probably, be attended with much benefit. We see however, that the Mosaic

---

*This arose from a pressure of the atmospheric plus electricity on the plumb line, which forced it towards the hill, then in a state of minus electricity. Indeed, the Scotch mountains in general may be supposed good conductors of electricity, being full of metallic spars and seams; but to this there are exceptions, as in the instance of the crags that environed the above-mentioned harbour.*

account of the creation is perfectly consistent with itself, and free from those embarrassments, with which other systems are inextricably clogged. It is absolutely impossible to show, how by any natural power a confused mass of matter, such as the chaos of the ancient poets, *Burnet* and *Woodward*, the comet of *Whiston*, † or the vitrified matter of *Buffon*, ‡ could put itself in the same order and settled disposition, in which we see the earth.

The *firmament*, † that setteth the waters apart,

---

† *Whiston supposed the earth to have been a comet, previously to the time of its commencement according to the Mosaic account, which then was placed by the Creator in a more regular manner, and changed to a planet.*

‡ *According to Buffon, all the planets in the solar system were originally parts of the sun, which had been detached from his body, all at once, by the mighty stroke of a comet. As to the earth, when it issued from the sun, it was in the form of a torrent of melted matter, and its interior parts he considers to be in a vitrified condition still.*

† *The word firmament is used by David for strength.*



will no doubt be universally understood a region of air, whose consistence is closer and more condensed than the interior region of air, which is immediately situated between the sun and the earth. This directs our eyes towards the polar extremities of that orbicular space, which is called heaven in general; there, immense columns of congealed or frozen air are to be found, which cape the poles of our globe to an extent of above 50 square degrees over each, and ascending thence to the waters above. Those aerial tracts remain necessarily in a most compressed and firm state, in consequence of their being deprived of the rarefying influence of the sun. In the book of *Job* we are told, the waters are hid as with stone, and that the face of the deep is frozen up.

That justly celebrated and uncommonly intrepid circumnavigator *Captain Cook*, in the southern latitudes of between 61 and 71 degrees, during the summer months in that hemisphere, had not only mountainous piles of ice perpetually to encounter, but also thick haze and close fogs. And the brave *Simoied*, who was engaged by the Rus-

sian court, not long ago, to travel over the frozen ocean, in a sledge drawn by dogs, so far as he could penetrate towards the north pole; after he had proceeded 400 miles upon ice, in the course of two weeks, was then obliged to desist from exploring those inhospitable regions, as he found the ice there beginning to rise in terrible heights and ridges, that overtopped one another. As to the imperfect and broken reports of several navigators, who pretended to have failed in some higher northern-latitudes than the 80th degree, they can hardly be relied upon. Travellers and old men have some sort of title to deviate from facts, as distances of every kind claim a right of imposing on us.

The figure of the earth, so far as mankind are able to guess, resembles a round ball: the Creator set a compass upon the face of the depth, says *Solomon*. It was the real opinion of the great *Hutchinson*, as well as of *Burnet* and many other naturalists, that the terraqueous globe is hollow, and not very unlike the shell of a nut or egg, when rid of their solid contents; this terrene crust, if it

could be viewed from its concavity, appearing as arched or vaulted over. There are many who think, that the earth is not of an exactly spherical shape, but protuberating considerably at the equatorial parts, and proportionably flattened about the poles. Others again are of opinion that it is perfectly spherical, because heights and hills can neither add nor take off more from its sphericity, than the inequalities upon the surface of an orange can take away from its roundness: this opinion was strenuously asserted by *Cassini*, in opposition to *Sir Isaac*.

It is usual to account for the spheroidal figure of the earth, from the greater centrifugal force of the equatorial parts than that of the polar ones. This explication is very deficient; the globe, which we inhabit, is composed of two different ingredients, earth and water; the former has a very considerable power of cohesion, besides a gravitating tendency, the latter has very little cohesion, and its parts may be separated from each other by whatever overcomes its weight. It follows, therefore, that the solid part of the globe cannot dilate so much as the fluid, because, by the strong cohe-

sion of its particles the centrifugal force is resisted. The water of the ocean, consequently, ought to swell and overflow the land about the equator, and this it should do at this present time equally as at the creation; that this should be the case is evident from the phenomenon of the tides.

It is not to be doubted but the attraction of the sun, moon, &c. somewhat affects the solid earth as well as the sea, near the equator, but on account of the greater cohesion of the former, it cannot yield as the ocean does; accordingly, the waters there are raised to some height towards it. The excess of the altitude, to which the waters would have covered the equatorial parts, in virtue of the centrifugal force, must have been proportional to the depression that is suspected to exist about the poles; amounting according to *Sir Isaac* and *Buffon* to  $17\frac{1}{5}$  miles, and agreeably to the opinion of other mathematicians to 25 or 26 miles.

Whoever accedes to the proposition of the earth being motionless, will all at once reject the notion of the equatorial countries protuberating, by the



centrifugal force of the globe, during its early diurnal-rotations. It would at any rate be insolent in us, as derogatory of the 'Divine power, to ascribe the height of those parts to the bulging of the globe, when newly finished, from an idea of its being then only a soft pulp, capable of yielding to any force from within, or an external attraction. Provided an oblateness at the poles exists, the elevation of the sea near the equator must consequently correspond so far with its depression at the poles, hence it would further follow, that the waters there, being more compressible than the land by any interior action, together with their well known preferable attraction from without, should rise and lay the whole equatorial countries under water to a few mountains.

If the figure of the terraqueous portion of our system was perfectly globular at first, and fashioned so by the creating Power then? It must ever since have remained so, as well as at this very day. It looks only a wanton and inordinate conjecture to fancy, that the north and south poles are twice 17 or 26 miles nearer each other, than two equatorial points,

diametrically opposite, are. Circumnavigators never made such near approaches to either pole, as put it in their power to give this question a tolerable and far less a decisive solution, and as little any trigonometrical observation has been as yet made near the equator, sufficient to give the supposition any shade of validity. That the altitude of hills and plains, about the middle parts of the globe, may arise, in some trifling degree, from the luxuriance of vegetation is not disputed; the crusts yearly added to the surface of the earth, in the torrid zone, are ~~do~~ doubt more abundant than in the regions of either the two temperate or frigid zones. The sward there being always replete with decayed vegetables and animals, whose organization is no more obvious to the senses, renders the inferior loam vastly rich and prolific: this, however, is not sufficient to convince us, that the mountains of Africa, Peru, &c. are the highest in the world.

That the high tides contribute to any elevation or increase of the earth about the middle of this globe, from an accumulation of mud, weeds &c.

there, is not very probable; for what the flux of the sea carries thither, the reflux constantly brings back.

*Sir Isaac* believed the earth might be a little higher under the equinoctial line than towards the poles, in the same way as is the case with a rod of iron; which in cold and frosty weather is not above one foot long, but when heated by climature or fire is lengthened to one foot and a fraction. He rests the phenomenon of the variation in the length of iron rods, belonging to pendulum clocks, when transported to different climates, on the testimonies of *Richer, Halley, De la Hire, Varin, Des Hayes, Couplet, Feuille* and *Picart*.

It is affirmed by some travellers, in answer to these *hypotheses*, that the highest and largest mountains do not lie within the torrid zone, but between the tropics and the middle of the two temperate zones, and the lowest from the polar circles towards the poles. No mountain in the equatorial kingdoms of the old continent, it is well known, can be compared to the Alps, some of

whose peaks are reckoned the highest pinnacles of land in Europe, Asia or Africa; the marine parts nevertheless, as well as the continents, have many inequalities between the tropics, as is evident from the incredible number of islands peculiar to those regions.

---

## SECTION XII.

*The same subject continued.*

**T**O what state else can the suspension of this hollow globe of ours be compared, but in some degree to the posture of a buoy anchored in calm water, or the aerostatism of a sac of rarefied air moored in a hazy and close atmosphere? Different scripture hints, the combined accounts of modern voyagers, who made unusual approachments towards both poles, and analogy by the easiest steps, leave us but little room to doubt of the polar ends of the earth being in a suspended situation, † by

---

† *A very intelligent gentleman, who often glanced the*



means of the firm pillars of frozen water and the compressed columns of congealed air projecting thence, and for ought we know to the contrary, stretching to the waters that are above the firmament. It is probable, that from the superiour waters situated, as it were, north of the zodiacal regions to those lying south thereof and through the centre of the earth, there is one great chain of

---

*the sky, with an astronomic eye, both from the western and eastern hemispheres, lately told a story to me, which he heard of a black-smith that seemingly was a practical and self-taught astronomer. The ingenious mechanic, discrediting the opinion of the earth being perpetually capering about, thought of putting this hard-pressed question to the test.*

*Considering the north pole-star the most stationary of all the bodies he was able to discover in the heavens, he took a gun barrel, and after severing the breech end of it he fixed the rest in a notch made on the sharp ridge of a contiguous small hill, and in a position that his eye could be easily applied to the one end of the tube, while the other took in the pole star. Now, says he, if the earth*

*moves*

elements always in the state of positive electricity. Where the electric fluid and air cannot have the liberty or play of reciprocal and self-action, there, excessive cold ever more prevails; hence it follows, that the whole linked substances in the above imagined semicircular course must be always positively electrified. Consequently, the fiery fluid is incessantly issuing thence into the interior and more rarefied aerial spaces of the universe, where it acts with more freedom and briskness, under the immediate influence of the sun; whose residence, by a cosmical law, is restricted to the equinoctial

---

*moves to the right or left of the star, or the star to the right or left of the earth, or granting that the absolute motions of both should tend the same way, though surely not with equal velocity; in either of all these cases it must follow, that an eye looking through a small tube like this will lose sight of that star in the course of a few hours.*

*Accordingly he, thus, took an observation at all hours of several clear nights during many years. The result of the experiment was, that he never found any greater variation in the site of the pole star than the inhabitants of Dover discover in that of Calais.*

bounds alone. On the other hand, the united actions, or heat of the sun and fiery fluid, produce negative electricity perpetually throughout the middle aerial regions of the universe. Now, all along the frontiers, so to speak, of the firmamental and solar aerial-tracts of the whole heavens where both come into contact, the pressure of the fiery fluid, in the intermediate spaces, between their positively and negatively electrified zones, being diminished, a general and prodigious attractive indentation and closure must take place. Over and above this external mode of suspension, there is, likewise, an internal electric-power connecting and supporting every particle of matter in the universe among themselves. For as well as the electric fire has a disposition to keep an *equilibrium* within itself, probably, it tends to equipoise its fellow elements too, through the whole frame of nature, because every motion of that agile fluid, produced on the one side of an atom, is immediately balanced by a corresponding one on the opposite side, and thus each particle comes to be

buoyed in its circumfused fluid. † Whence, we may perhaps suppose, that the whole atoms of the earth gravitate no more upon one another than the cells of a honey-comb do among themselves.

If small electric bodies, for example, two bits of load-stone suspend a needle between their poles in the air, what is to hinder a measure of the same magnetic power to poize the Andes, from Magellan's straits to the isthmus of Darien? †

---

† *Know first, that heav'n and earth's compacted frame,  
And flowing waters, and the starry flame,  
And both the radiant lights, one common soul  
Inspires, and feeds, and animates the whole.  
This active mind infus'd thro' all the space,  
Unites and mingles with the mighty mass.  
Hence, men and beasts the breath of life obtain.  
And birds of air, and monsters of the main,  
Th' etherial vigour is in all the same,*

VIRGIL.

---

† *A natural cause here occurs for the relative direction,  
which mountains describe on our globe, in both the old  
and*



The *phenomena* of the *aurora borealis* strengthen the credit of the preceeding theory. This meteor begins to appear in our hemisphere from the northern spaces of the heavens, always proceeding towards the south, but never from south to north; hence, it is very reasonably concluded, that there is some extraordinary connection between the poles of the earth and it. The fiery pillars and balls observed in Greenland, Nova Zembla, Siberia &c. are sufficient indications of the polar atmospheres being continually in a high electrified condition, discharging elementary fire thither into the equinoctial spaces, where the air, by mean of

---

*and new continents. Those of the former, stretching like a great bar from east to west, tend perhaps to conduct the magnetic libration of the globe in that line on one side. Thus, the Alps form one continued chain that takes its course across the whole eastern continent from Spain to China; they begin upon the sea-coast of Galicia, join the Pyrenees, traverse France by Vivares and Auvergne, run through Italy, and extend into Germany, above Dalmatia, until they reach Macedonia; thence, they join the mountains of Armenia, the Caucasus, the Taurus, the Imaus, and at last terminate on the coast of Tartary.*

Mount

the excessive heat of the sun, becomes a conductor of electricity. In the same way as hot air, so hot glass, melted rosin, sealing wax &c. are all conductors till their heat is dissipated, but then again they become non-conductors.

For along time it was in dispute, whether or not this meteor appeared in the northern hemisphere only, or if ever it was observed in the southern one. This question is now finally settled and decided by Mr. *Foster's* observations; who, upon his travels in the southern hemisphere, in

---

*Mount Atlas, in the same manner, traverses the whole continent of Africa; from the kingdom of Fez it runs to the straits of the red sea. The situation of insular mountains is generally similar; for example, the Grampian, Pentland and Cheviot hills in Scotland all run from east to west. But to this established direction, there are exceptions, viz. the opposite sites of Dofrefield and Hardanger in Norway, Balagate in India, &c.*

*The long ridges and chains of lofty mountains, lying from east to west, within the temperate zone, on the eastern hemisphere, serve, beside the natural use now mentioned and many more, to stop the evagation of vapours*

company with *Captain Cook*, saw streamers during several nights in a high south-latitude, which consisted of long columns of clear and white light, shooting up from the horizon eastward and almost to the zenith, and spreading gradually over the whole southern part of the sky.

---

*pours towards the pole, without which they would all transpire from the hot countries, and leave them perpetually, to the ruin of agriculture, destitute of rain. In the western hemisphere, there was less occasion for such a provision being made by the hand of nature; it is the general received opinion, that the kingdoms of Mexico and Peru did not exist four centuries prior to the discovery of America by Columbus, and it is not doubted but south America was peopled, at first, from the Asiatic islands in the southern ocean, long before north America was overrun with infinite tribes of Indians. Therefore, we may suppose that the world was created five thousand years before a human foot, perhaps, had stepped upon American ground. Though the medly of inhabitants there now, composed of red and copper-coloured aborigines, white and brownish intruders, and enslaved herds of wretched Africans, do not experience the most steady mediocrity of clime, yet, bountiful nature recompenses this in other respects.*

The visible diffusion of the fiery fluid in the instance of the *aurora borealis* about the poles, and which is always again verging thence towards the equator, may confirm the opinion, that the general operation of the electric fluid produces an universal coalition and equilibration from one side of our system to the other, not only within itself, but at the same time between all the atomic parts of the airy, watery and earthy elements at large.

Dr. Halley was of opinion, that the earth is hollow, having a magnetic sphere within, which corresponds in virtue with all the natural and artificial magnets upon the surface. Hence, the magnetic *effluvia*, passing through the earth from one pole of

---

*The Andes, or Cordilleras, Apalachian mountains &c. extending almost from Cape Horn to the country of the Esquimeaux, seemingly like a second bar crossing the oriental one, may possess so much electric fire, as poizes that side of the globe, from pole to pole.*

*Says Derham, the earth and water are so handsomely, so workman-like laid every where, that there is a just equipoise of the whole globe. The Northern balanceth the Southern ocean, and the Atlantic the Pacific ocean. The American dry land is a counterpoise to the European, Asiatic and African.*



the central magnet to the other, might become at times visible in their course, which he thought was from north to south, and thus exhibit the beautiful coruscations of the *aurora borealis*. Here, it may be remarked, this learned man was in some measure totally ignorant of the powers of electricity; therefor, he was obliged to work with such materials as he had. Had he known, that a stroke of electricity could give polarity to a needle that had it not before, or reverse the poles of one that had it, he certainly would have concluded, the electric and magnetic *effluvia* to be the very same, and that the *aurora borealis* was precisely the fiery fluid in certain circumstances performing its circulation, from one extremity of the universe to the other.

*Becaria*, adopting Halley's sentiments on this subject, says, since the sudden stroke of lightning gives polarity to magnets, it may be conjectured, a regular and invariable circulation of the whole mass of the fluid, from north to south, may be the original cause of magnetism in general. That is,

truly, a great thought, says Dr. Priestly †, and if just, bids fair to introduce greater simplicity into our conceptions concerning the laws of nature. Those electric currents may arise not only from one source, but from several springs in the northern hemisphere, adds *Becaria*, and the aberration of their common centre from the north point may be the period of its variation, and the obliquity, with which the current strikes into the earth, may be the cause of the needle's dipping, and also, why bars of iron receive magnetic virtue more easily in one particular direction. He supposes, the northern twilight may be this electric matter, performing its circulation in such state of the atmosphere as renders it visible; accordingly very vivid appearances of this sort have been observed to occasion a fluctuation in the

---

† *This is the very ingenious and learned philosopher, who lately, by his experiments in pneumatics, discovered the true composition of the atmosphere.*

*To decompose the subtile and invisible fluid we daily breathe, to be able to recompose it again, and produce air either salutary or noxious, as we please, seem to be one of the highest discoveries ever made by man.*

magnetic needle. Upon the whole, this meteor is considered now no more than the mild flashings of electric matter, whose course is evidently directed from both poles towards the equator, and not from one pole to the other, as was formerly thought.

During these 20 years and upwards, navigators have observed a tendency in the compass needle to vary westward in high north latitudes, and the variation is now increased to two or three points: the nearer the torrid zone is approached this variation diminishes till the needle at last resumes due polarity. The natural cause of this phenomenon is not generally understood, *Becaria* assists us to unriddle it.

We know, if the sun sets out, as from any star or other fixed point in the heavens, the moment when he is departing from the equinoctial or north-tropic lines, that he will come to the same equinox or tropic again 20 minutes and  $17\frac{1}{2}$  seconds of time, or 50 seconds of a degree before he completes his course, so as to arrive at the same fixed star or point whence he set out. For the equi-

noctial points recede 50 seconds of a degree westward from the north pole every year, that is, contrary to the sun's progressive annual motion northwards.

When the sun arrives at the same equinoctial or solstitial point, he finishes the tropical year, which is found by observation to contain 365 days 5 hours 48 minutes and 57 seconds: and when he comes to the same fixed star again, he completes the sidereal year, which contains 365 days, 6 hours, 9 minutes and  $14\frac{1}{2}$  seconds. The sidereal year is therefore 20 minutes and  $17\frac{1}{2}$  seconds longer than the solar or tropical year, and 9 minutes and  $14\frac{1}{2}$  seconds longer than the Julian or civil year, which is stated at 365 days and 6 hours; thus, the civil year is almost *a mean* between the sidereal and tropical.

Now, from the shifting of the equinoctial points away from the north point of the earth thus a little every year nearer the south-west, we come to understand how the west side of the firmament may be in a more rarefied and so in a more conducting condition than the very polar space; and as the



common centre of all the electric currents running from north to west must necessarily be established among conducting preferably to nonconducting zones; thence, the lateral direction of those currents occasions a sidewise variation of the needle. As to the return of its polarity in the equatorial clime, it is evident, that this arises from the more equable expansion of electricity there; from the same cause a *pendulum*, which vibrates seconds near the poles, vibrates slower and more weakly near the equator, as it is there lighter, being less disturbed by electric attractions either from the atmosphere or earth. †

---

† The preceeding observations likewise explain, as the latitude of Scotland is a little every year falling out of the sun's influence, consequently, that this is the very cause of our experiencing later springs and colder summers for near half a century than formerly. On the other hand, the profuse inset of fiery fluid now into the southern division of the globe must be followed by a more copious discharge and rapid circulation of it through the northern; hence, the late mildness of our winters may arise. This corresponds with another fact

The fact is acknowledged, that the sun, as the source of the fiery fluid, is continually attracting and repelling as well as converging and diverging it to and from himself. Its egress and ingress, however, do not happen as if a ball was shot from the muzzle of a cannon at a mark, and straight back from the mark to the cannon again; its migration is rather performed mediately though suddenly by the charging and discharging of aerial zones, alternately and successively, from the centre of the sun to that of the earth, and *vice versa*. The positive and negative inflations of aerial zones with fiery matter may, in some shape, be compared to the currents observed in parts of the sea near cataracts, where many central points are seen, to-

---

*fact, and that is, how places in high north latitudes have been more than usually harassed with earthquakes in modern times, viz. Portugal, Italy, Sicily, Asia minor, Japan and the north east extremities of Asia. In the torrefied regions, this evil may happen ab extra without a subterraneous cause, but that is preceded by particular aerial-prognostications; whereas, a subterraneous electric-cause previously produces other indications, quite different in appearance.*

wards some of which there is a strong conflux, and from other points a precipitate lapse of the water, agitated in different directions; nevertheless, the sea maintains a *plenum* there, fully as much as where it appears still and smooth.

To follow the comparison, the electric fluid moves to and fro in the spaces between the sun and the atmosphere of the earth, in an easy and peaceable manner, having nothing to resist its circulation, as we may judge from the *phenomena* of streamers. But in our atmospherical zones the case is very different; there, the fluid meets frequently with resistance, from whence arise lightning, thunder, hurricanes, meteors and other indications of a violent excitation in it.

Now, we may come to understand, how that auspicious division of the earth, which is the sun's mark, may be magnetically librated by the joint actions of those different directions of power, which embrace and clasp it from east to west and counter-ways, just as happened in the experiment of the cork-ball.

It is not to be understood, that the operation of the fiery fluid abates, or at all ceases at the surface of the earth; it penetrates from our atmo-

sphere, by the minutest interstices, through the beds of the terrene shell, † to the great cavity thereof, which, perhaps, contains some kind of spirituous vapour or gas. The electric matter, again in its retrograde circulation from the terrestrial abyss to the surface, may sometimes set out so profusely that the conduits of the earth are not capacious enough to convey it, while the pressure behind is unsurmountable. Then local convulsions and commotions of the earth and sea, with a train of other *phenomena*, unavoidably happen; events usually ascribed to subterraneous fire, discharging here and there like a great mine.

Says *Cicero*, nothing is more admirable than how the world is established, and its cohesion rendered so firm as to endure; nothing, indeed, can be conceived fitter, for the whole parts of the frame of nature press equally from all sides to maintain their common centre. It is particularly wondrous, how the aggregate bodies thereof continue always

---

† The fourth part of this shell is reckoned only dry, three-fourths of its surface, for the easy permeation of the fiery fluid, being moistened with the ocean, seas, creeks, lakes, rivers, rills, canals, marshes, squalid tracts &c. thereupon.



joined among themselves, as if they had been encircled and bound together by some strong band; which that *nature*, diffused throughout the whole universe, accomplishes; conducting every thing with understanding and judgment she turns and pulls the extremities to a centre.

I might add something, says *Sir Isaac Newton*, concerning a certain most subtile spirit, which pervades and lies hid in all gross bodies, by the force and action of which, the particles of those bodies mutually attract one another at near distances, and cohere if contiguous.

The world is not heavy, the Stoic philosophers maintained, because, the whole fabric thereof is made up proportionably of heavy and light elements, and the earth's place being in the centre, whether such bodies tend, it thus keeps a fixed posture.

There are few considerably cool and serious persons, whose sagacity will not oblige them to eye the Copernican errantry at best but a mere paradox, nay a Quixotic story; in other words, a pregnant fiction, that would blind our eyes, benumb our thoughts and judgment, and place us all in much the same predicament with a well

known knight-errant and his squire, who after being hoodwinked and mounted upon a wooden horse pleasantly undertook a long journey through the sky, equally bent on pursuing feats in chivalry as *Phaeton* was to get the guidance of his father the *Sun's* chariot for one day.

Let us preferably lean to the more early and respectable authority of *Diogenes Laertius* the Greek biographer, who flourished in the second century, as likewise to the testimony of *Pliny* the elder, a Roman natural historian of the first century, and believe both, who were men of great honour and veracity, that *Pythagoras's* real and firm opinion was, that the universe is round, containing the earth immovably suspended in the centre.

The centre of the worldly system, says *Sir Isaac Newton*, being immovable, is a circumstance acknowledged by all, while some contend, it is the earth, others, the sun, that is fixed there. Thus far, but no further, he, who stands first in the first rank of astronomers, proceeded in the solution of the present inquiry.

22 JY 59

THE END.

**r  
n  
n  
7  
r**

**l**

**e**

**l**

**A**

**e**

**.**